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UNITED STATES NAVAL INSTITUTE PROCEEDINGS

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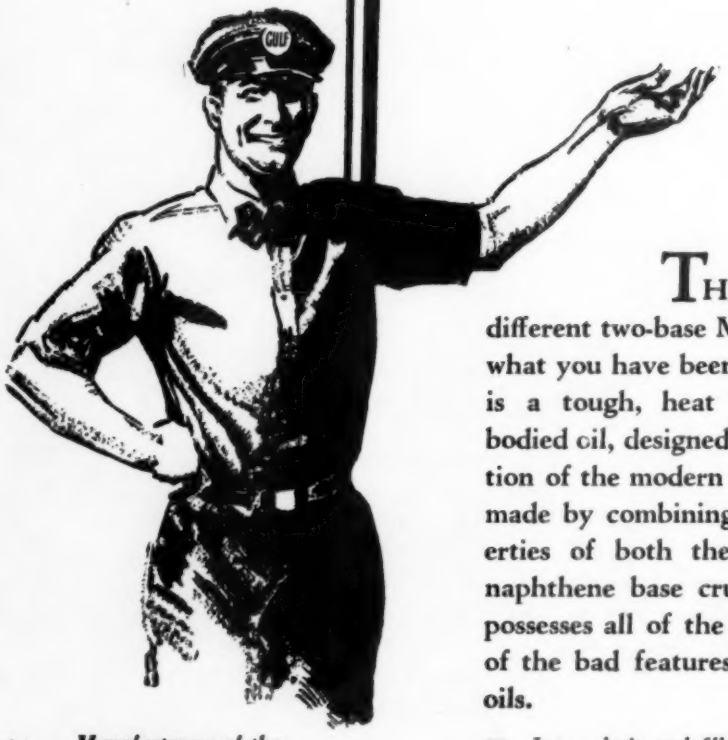

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THE AIR SHOW THAT NEVER WENT ON, HAS ITS PRELIMINARY IN FLIGHT OVER THE CAPITOL DOME

This beautiful scene shows the squadrons of planes from the plane carriers *Saratoga* and *Lexington* in flight over the Capitol. This was the preliminary to what was to be the annual Curtiss air races. Due to a storm, the races were postponed for a week.

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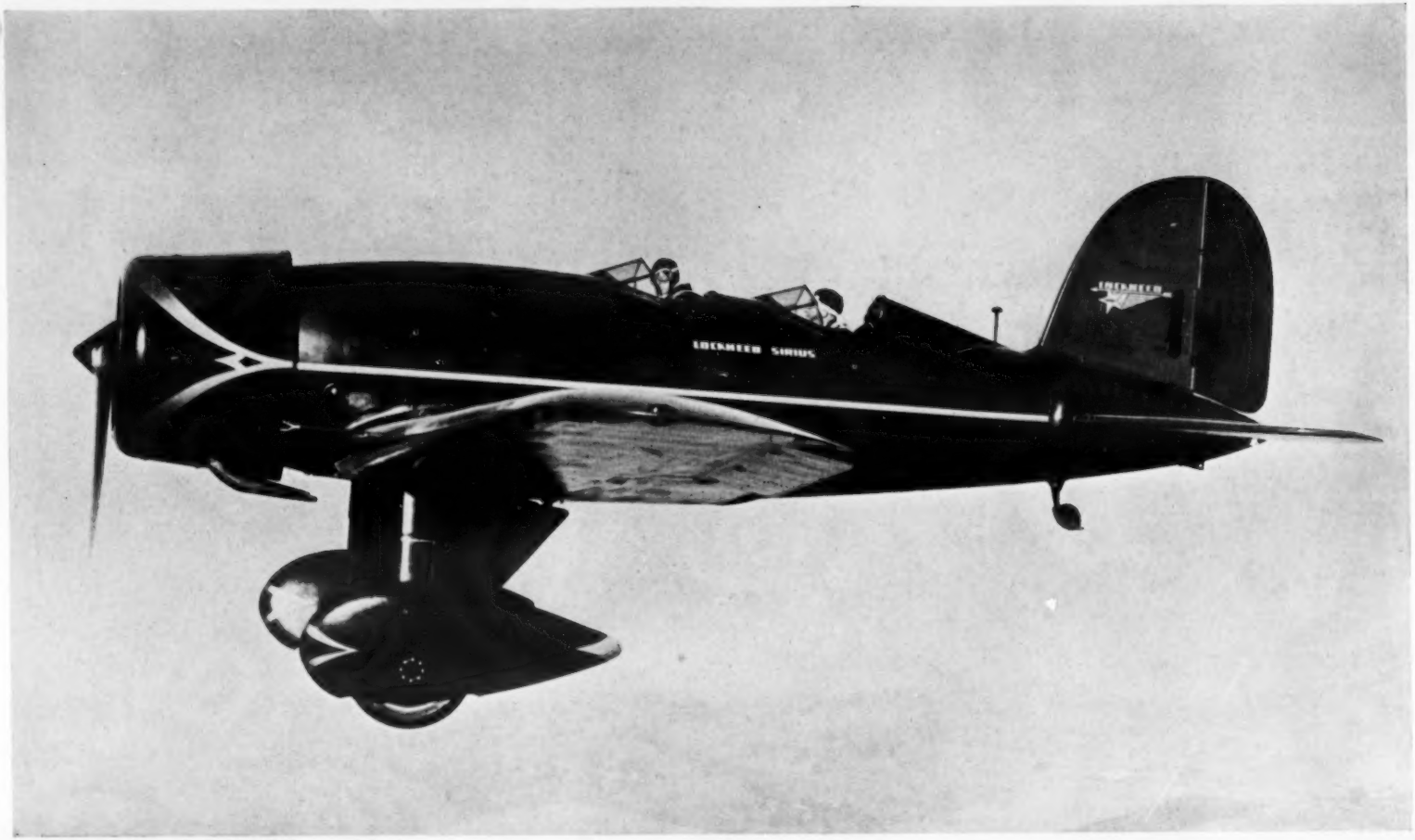
READY TO ENTERTAIN PRESIDENT HOOVER WITH THEIR FORMATIONS

Aërial view of the Aircraft Squadrons of the Battle Fleet drawn up in formation at Anacostia Naval Air Station. President Hoover reviewed the maneuvers.

Aërial view of the Aircraft Squadrons of the Battle Fleet drawn up in formation at Anacostia Naval Air Station. President Hoover reviewed the maneuvers.

Courtesy Detroit Aircraft Corporation

THE DETROIT "GULL" GLIDER BUILT BY THE DETROIT AIRCRAFT CORPORATION, IN FLIGHT IN GERMANY

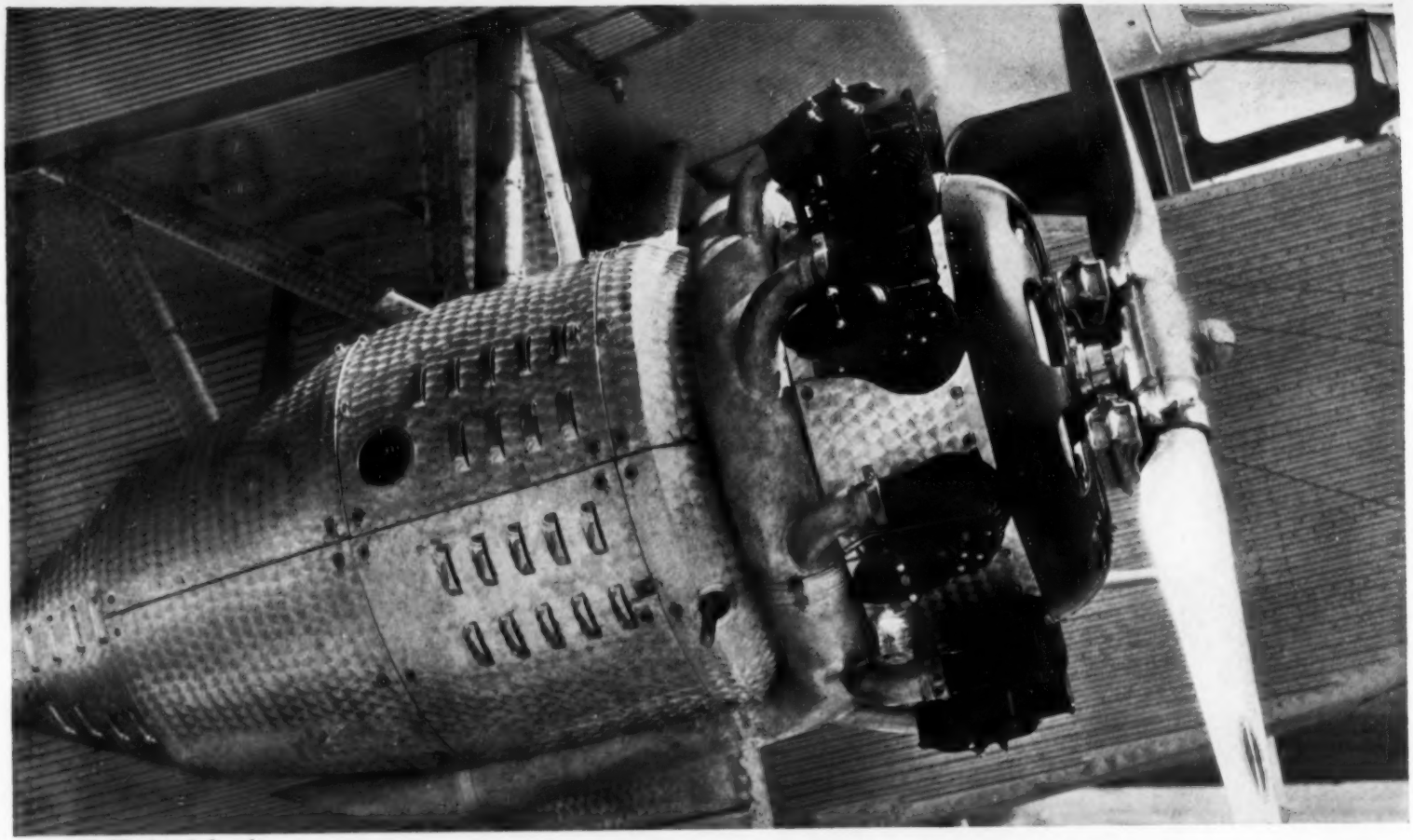


Courtesy Detroit Aircraft Corporation

LOCKHEED SIRIUS

Colonel Lindbergh chose this model for his own personal use. It was built by the Detroit Aircraft Corporation.

Colonel Lindbergh chose this model for his own personal use. It was built by the Detroit Aircraft Corporation.



Courtesy N. W. Ayer & Son, Inc.

PACKARD DIESEL ENGINES INSTALLED IN A WING NACELLE OF A FORD 4-AT TRANSPORT

The plane, powered with the first Diesel engines of this type to be installed in a multi-motored transport plane, was shown at the All-American Aircraft Show, Detroit.

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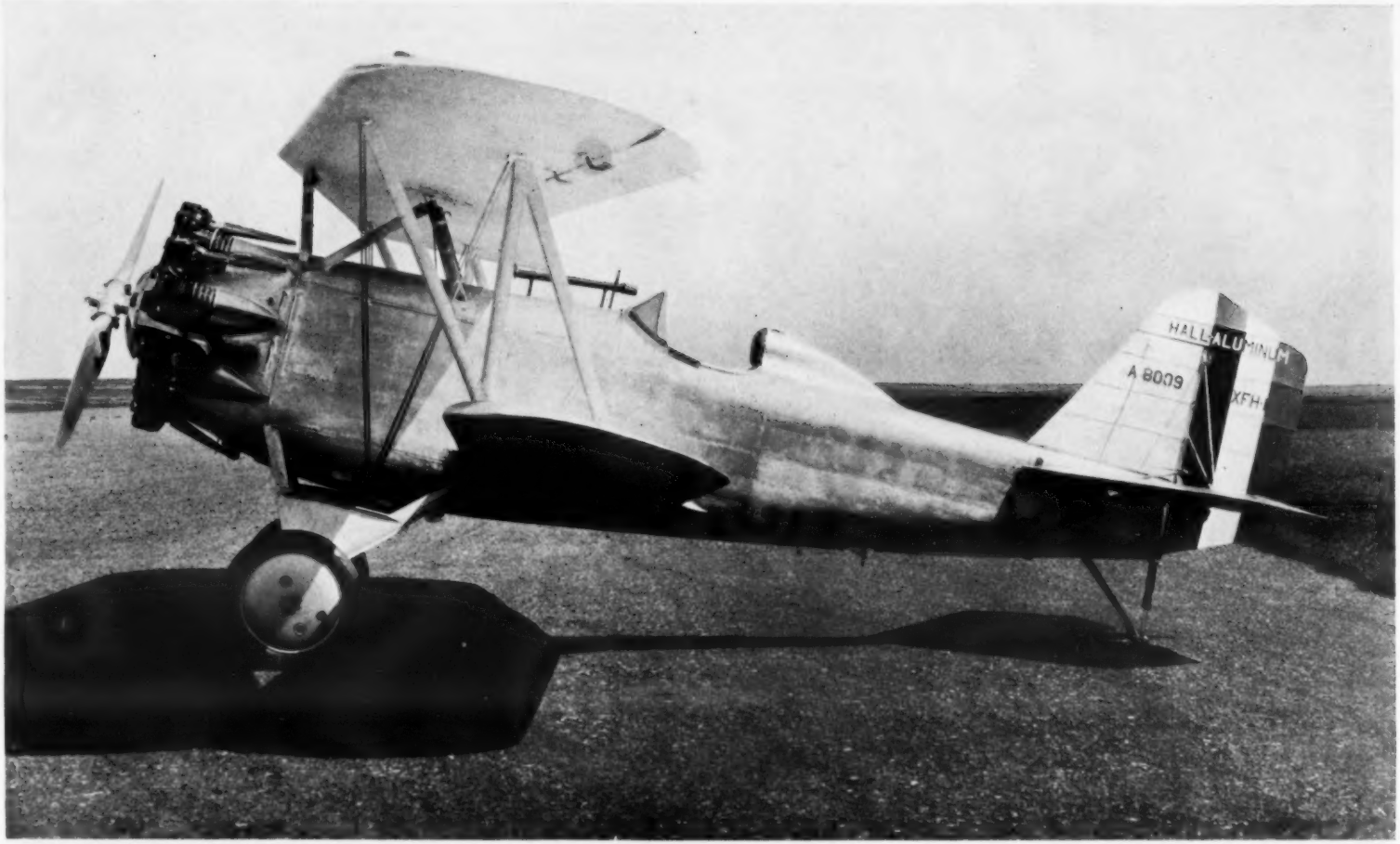

Courtesy Hall-Aluminum Aircraft Corporation *Photo by Johnston & Johnston, Inc.*

HALL XFH-1, SHIPBOARD FIGHTER

The fuselage, of monocoque construction, is made water-tight to provide flotation.

The fuselage, of monocoque construction, is made water-tight to provide flotation.

International News Photos, Inc.

AIR "RAID" ON THE GOLDEN GATE

The seventh bombardment group from Rockwell Field, San Diego, participates in a thrilling air raid over San Francisco, as a part of its maneuvers. The air army was controlled by radio from the flagship, in which Major Carl Spatz made his flying headquarters. Bombers and pursuit planes participated in the exhibition. The bombers are shown above flying over Suisun Bay.

Courtesy Pratt & Whitney Aircraft Company

BIRDS OF THE AIR AND SEA BACK IN THEIR NEST

Looking down on the aircraft carrier *Lexington* with its armada of Hornet-powered Martin bombers on its deck, after maneuvering in the air off the Virginia Capes.

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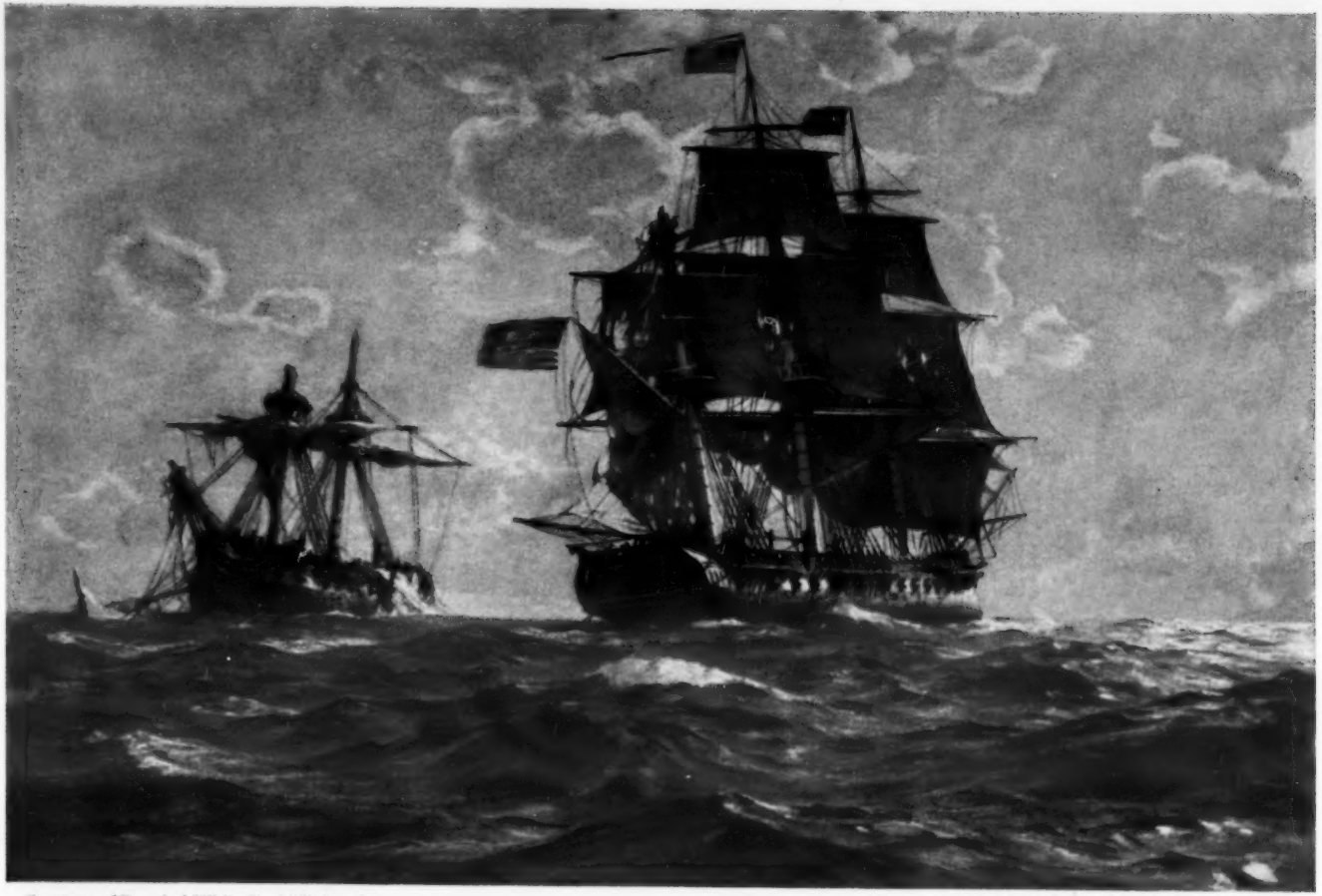

Courtesy of Berwind-White Coal Mining Co.

From a Painting by Charles Robert Patterson
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UNITED STATES AND MACEDONIAN

The second frigate action of the war of 1812 was fought within a few days sail of the Canary Islands. The British frigate *Macedonian*, on the lookout for American ships far from their home waters, and particularly the frigate *Essex*, came in sight of the frigate *United States* on Sunday morning, October 25, 1812. A good breeze was blowing from the south-east, and the semi-tropical sea sparkled in the sunlight.

UNITED STATES NAVAL INSTITUTE PROCEEDINGS

Vol. No. 56, No. 8 AUGUST, 1930 *Whole No. 330*

Aircraft *and the* Naval Engagement

By LIEUTENANT LOGAN C. RAMSEY, *U. S. Navy*

New weapons do not change the rules of warfare but only their application

ANY discussion of the function of aircraft in the modern naval engagement must be prefaced by a consideration of the number and type of aircraft that will be available to each of the opposing fleets. The naval forces of nations upon which circumstances or considerations of policy force the offensive rôle in the naval campaign are necessarily dependent upon aircraft carried on shipboard. States which, by reason of their geographic position, national policy, or other factors, are apt to assume the naval offensive in the event of war are accordingly committed to a naval policy involving the carrying of the maximum possible number of aircraft by their fleets. To these nations the policy of absolute naval control of the fleet aircraft is mandatory.

On the other hand, a state which, in all probability, will be forced to accept the defensive rôle in the naval phases of the war may be considered as having a greater latitude in its choice of policy in this respect. The theater of operations being near its coasts, the issue of a major naval engagement undoubtedly could be avoided without great sacrifice until the commander of its fleet could depend with certainty upon the supplementing of his aërial forces by aircraft based on shore. To a nation so situated, particularly in view of existing limitations upon naval armaments and the absence of any such limitations on aircraft, considerations of national defense seem to require the maintenance of an adequate shore-based air force. The latitude in the choice of national policy previously mentioned is now apparent. If the aërial force in question may be required for complementing operations on either land or sea, a unified air force with a supplementary fleet air arm appears feasible. But if these shore-based aircraft exist primarily for naval defense, complete naval control is appropriate.

In either case, the fleet required to assume the offensive must be prepared to contend not only with the aircraft carried by the opposing fleet but with the large numbers of planes based ashore as well. For, to quote from a statement of the then president of the Naval War College, made, I believe, in 1927: "One of the outstanding lessons of the War College tactical maneuvers of the past two years has been that no fleet can enter a hostile zone unless it has, beyond a doubt, superiority in the air. This means superiority not only to the enemy fleet-based aircraft, but to his fleet- and shore-based aircraft combined." Under these restrictions, offensive naval warfare is faced with an almost prohibitive handicap in the absence of overwhelming surface strength. Even in the case where the contending nations are in sufficient geographic proximity to permit of the supple-

Action on the lookout for American ships far from their home waters, and particularly the frigate *Essex*, came in sight of the frigate *United States* on Sunday morning, October 25, 1812. A good breeze was blowing from the south-east, and the semi-tropical sea sparkled in the sunlight.

menting of the operations of the fleet assuming the strategical offensive by shore-based aircraft, an avoidance of a major engagement, until the fuel supplies of such aircraft are exhausted, is a course of action open to the fleet acting defensively.

Therefore, it may be conceded that a great superiority of surface strength is now necessary to the assumption of the offensive in a naval campaign. With the existing limitation on naval surface strength, sufficient ships are not available to any of the great powers for such purposes except in the event of war with one of the smaller nations, or of an alliance with another of the powers. In the absence of such an alliance, the additional ships necessary to the successful undertaking of the naval offensive against a nation of equal rank would have to be constructed subsequent to the declaration of hostilities and after notification of the other signatory nations to the Limitation of Naval Armaments Pact, as provided for in Article XXII of that treaty. Hence, in the unfortunate event of war between any two of the great powers, we may reasonably expect a period of comparative stagnation in the naval phases of the war until such time as the logistical resources of one nation enable it to outstrip the other in a naval construction race sufficiently to justify it in assuming the naval offensive.

Hence, it may be assumed that in the next naval campaign the fleet acting offensively will possess a preponderance in surface strength and a considerable inferiority in the total number of aircraft available. This numerical inferiority in aircraft would arise from the prohibitive cost of constructing a sufficient number of aircraft carriers to transport enough planes to match the maximum number of shore-based aircraft which the enemy could launch. A shore base capable of providing facilities for five hundred may be constructed for about the same cost that would be involved in the building of an aircraft carrier capable of basing only fifty planes. The cost, therefore, of providing a mobile base of operations for aircraft is roughly ten times as much as for a shore base of equal capacity. While such a disparity can be endured to a certain degree it does not extend to the maximum strain that can be placed upon the entire resources of a nation.

Therefore this numerical inferiority in aircraft must be accepted as concomitant to the assumption of the offensive in naval warfare. If this is conceded, the problem then becomes one of consideration of the means by which the fleet acting on the offensive can, by a judicious selection of types of aircraft, most nearly offset this disadvantage. The preponderance in surface strength of this fleet is assumed to be great. Hence the logical and most efficient means of destroying the hostile surface fleet is by gunfire. An aërial striking force, consisting of types of planes capable of destroying capital ships of the enemy, is not needed. The inferiority in surface strength of the defensive fleet is so marked that it, in itself, does not form a serious menace to the safety of the offensive fleet. It could form such a menace only if, by attrition, it is able to reduce greatly the offensive surface strength. Its only real means of menacing the offensive fleet is from the air. Therefore, an aërial striking force within this fleet to harass or aid in destroying defensive surface craft not only is not needed but its presence in the fleet would reduce the number of aircraft available that could be used as a means of defense against aërial attacks.

At present the classification of an aërial striking force covers types of planes capable of carrying heavy bombs and torpedoes. These types, and particularly the heavy bombers, must occupy, because of the aërodynamical requirements of their design, more space than an equal number of fighting or scouting planes. Therefore, the elimination of heavy bombers and torpedo planes would result in the ability of the fleet to base a greater number of aircraft on its carriers than would be possible otherwise. In addition, the number of planes capable of repelling aërial attacks would be greatly increased. Thus the proposed change of types would not only increase the number of aircraft within the offensive fleet but would also increase the percentage of the more essential types.

With the elimination of the torpedo and bombing planes from the offensive fleet, its aircraft would be based as follows: scouting planes on the cruisers; on the capital ships, planes for observing their gunfire; and on the carriers, fighting planes exclusively —with the exception of a small number of scouting planes.

In the fleet acting defensively different considerations obtain. The great inferiority in surface strength necessitates the employment of all possible means of attrition of the enemy ships. A favorable opportunity for attacking the aircraft carriers of the offensive fleet may be presented prior to the arrival of the shore-based planes, and, with the assurance of aërial reënforcements, it is not vital for the commander of the defensive fleet to conserve his aërial strength, if its expenditure results in a compensating reduction in the surface strength of the enemy. Therefore, in the fleet acting on the defensive, all types of aircraft, including an aërial striking force, are required.

It is true that the limitations of space, weight, and other considerations necessitate the modification of the design in heavy bombers and torpedo planes for shipboard use so that they are not quite as efficient in the performance of these missions as similar types designed for operation from shore bases. Nevertheless the shipboard planes of these types are capable, under favorable conditions, of destroying any ship afloat so that their inclusion in a fleet acting defensively is quite justifiable.

In this fleet, accordingly, are to be found all types of aircraft, flying boats excepted, distributed as follows: scouting planes on the cruisers; on the capital ships, planes for observing their gunfire; and scouts, bombers, fighters, and torpedo planes on the aircraft carriers. This force is supplemented by aircraft of all types arriving from the shore bases. One modification of this distribution may develop within the next few years. Efficiency of design in the heavy bombing plane, which must carry a considerable load to fairly high altitudes, necessitates a comparatively great wing span. This, even when the design permits of the folding of the wings, results in considerable difficulty in handling these planes on the deck of a carrier. In addition, they occupy a disproportionate amount of space. The immediate future may disclose, for these and for other reasons, that heavy bombers are *de trop* on shipboard and that greater over-all military efficiency and striking force may be obtained by substituting a slightly greater number of torpedo planes, as that type does not require quite as much space for each plane. Among the shore-based planes, where the great wing spans of these planes do not constitute such a great problem, seems the logical place for this type.

It must not be construed from any of the foregoing arguments that a nation should, in time of peace, fail to include in the aircraft of its fleet all pertinent types of planes. For even a nation which might reasonably expect to assume the naval offensive against any single adversary could, if faced by a hostile alliance, be forced to accept the more passive rôle. Therefore, it seems incumbent upon every nation to develop during peace time all types of naval aircraft to be prepared for just such a contingency. The suggested distribution of types within a fleet acting on the offensive could be effected, in the event of war with a single enemy, almost immediately after the declaration of hostilities, there being no great difficulties logistically in substituting the required additional fighting planes in lieu of the bombing and torpedo planes on the carriers.

If the foregoing is accepted we may then assume that in the naval engagement of the immediate future the strategical offensive will have a numerical superiority of aircraft carried *in* the fleet but an inferiority in the total number of aircraft available. The other fleet, while numerically inferior in *fleet* aircraft, will possess an aërial striking force and an over-all numerical aërial superiority.

Tactically, the first fleet will be on the offensive at the surface and on the defensive in the air. Its commander will obviously endeavor to engage the enemy at a place or time when the planes based ashore would be unavailable, while his adversary will seek to avoid an engagement under such conditions.

The fleet on the strategical defensive, assuming that it is able to avoid an engagement until assured of the support of all of its aircraft, will also attempt to destroy the hostile aircraft carriers prior to a major engagement. The accomplishment of this objective would be well worth the expenditure of the whole of its fleet aircraft and a portion of its surface strength as well. If such a disaster should be suffered by a fleet on the offensive it would instantly become a fleet on the defensive. Immediate retirement from the hostile zone would be the only possible safe maneuver.

In the absence of fortuitous circumstance,

it seems probable that neither commander could, against an able opponent, attain either of these early objectives and we may therefore picture the general engagement as taking place with comparatively unimpaired forces on both sides. For the purposes of this discussion there are three different types of engagements from the aërial standpoint, in each of which the potentialities of aircraft differ widely. These types are: the day engagement with average to maximum visibility; the day engagement under reduced visibility conditions; and the night action.

In the day engagement under good visibility conditions the primary contact with the enemy, made by the fleet acting on the strategical offensive, will probably come from one of the planes launched from a light cruiser—in other words, a plane engaged in strategical scouting. Primary contact for the other fleet may come from aircraft having analogous missions or possibly from a shore-based patrol plane or dirigible. Planes scouting strategically usually would be unsupported by fighting planes. These scouts would ordinarily first report contact with the enemy's outer screen. This being accomplished they should continue on and endeavor to obtain information regarding the inner screen and finally the enemy main body. Once this has been accomplished they are of little further value. Lacking support, they would fall an easy prey to hostile fighters or even if they could avoid hostile aircraft and antiaircraft fire, they can hardly be taken aboard their cruisers again. The carriers will be too distant for their return to these bases and even if they were near enough, the carrier planes would be massed on deck and thus preclude the possibility of their landing aboard. The fuel capacity of these scouting planes is comparatively limited and they cannot remain in the air indefinitely. Therefore, they may be considered as expended once they have reported contact with the enemy main body. Instead of waiting to be shot down ingloriously by hostile fighters while attempting to escape or being forced down by the exhaustion of their fuel supply, they should continue onward and endeavor to damage the flying-off decks of the enemy aircraft carriers by diving bombing attacks. While the weight of the bombs that they could carry would be insufficient to menace the safety of the carriers, still, the successful bombing of the carrier decks with the resultant damage to the massed aircraft awaiting the signal for take off and to the deck itself, might seriously impede the operations of these vessels.

Subsequent to the receipt of the first contact information, the carrier planes will be ordered to take off and, from the defensive fleet, the shore-based planes as well. The objective in the offensive fleet would be, first of all, the defense of its aircraft carriers and then the protection of any scouting group that might be dispatched from the carriers. For the aircraft of the defensive fleet there is, at this stage, but a single objective—the destruction of the hostile aircraft carriers.

The first aërial fighting will gravitate towards the aircraft carriers of the offensive fleet. These vessels probably will be placed well in rear of the fleet and will therefore be comparatively safe from surface attack. They can be seriously menaced only from the air or possibly from beneath the surface. If they are destroyed by hostile aircraft or other means, the remainder of the fleet must endeavor to break off the action unless it is certain that the enemy surface strength can be destroyed in short order. Otherwise the commander of the defensive fleet can delay matters by discontinuing the action, while maintaining contact, until all of the aircraft of the opposing fleet are either shot down or forced down due to the exhaustion of their supplies of fuel. The planes of the defensive fleet, in this case, can refuel from their carriers or shore bases and thus maintain control of the air. The capital ships of the offensive fleet would then be hampered in their gunfire by the lack of observing planes. Their situation would be like that of a blind heavyweight boxer attempting to crush a smaller opponent who retained command of all his faculties.

However, in view of the comparatively great number of fighting planes in the fleet air arm of the offensive fleet and the fact that after launching their planes these carriers would probably retire to a distance, the success of an aërial attack by the fleet air force of the defensive fleet on these vessels is problematical. But if they are close to the enemy when or before their planes are launched, or if the defensive fleet should be able to make a coördinated attack using both the fleet air arm and its shore-based

planes, these carriers would be in serious danger.

A detailed discussion of the proper disposition of the aircraft carriers in cruising and battle formations is beyond the scope of this paper, but the preservation of these vessels both prior to and after launching their planes is a matter of such vital importance to the offensive fleet that it would seem that their employment in the scouting line when contact with the enemy fleet might be reasonably expected, would be a mistake. Even one or two hits from major-caliber guns or heavy bombs could easily destroy the usefulness of these ships as bases for aircraft operations, even though their water-tight integrity should remain unimpaired and the ships, except for their flying decks, practically undamaged.

Conversely, the carriers of the defensive fleet, while of great importance, are not so vital, particularly if their planes are launched prior to their destruction. The aircraft of these vessels surviving the aërial fighting can easily use the shore bases for future operations—a course of action not open to the opposing aircraft. Thus, generally speaking, the vital spot—the solar plexus of the offensive fleet—is its aircraft carriers; while the greatest weakness of the defensive fleet is its inferiority in surface strength.

Assuming that the carriers of the offensive fleet are able to launch their aircraft and retire to a safe distance, a certain percentage of these planes can be held to assist in the protection of these vessels from aërial attack and the remainder released for the protection of the main body against aërial attack. The planes so released then have three missions: protection of the planes observing gunfire of their capital ships; protection of the capital ships themselves from aërial attack; and protection of the carrier scouting planes from hostile fighters. As the main weapon of the offensive fleet is gunfire from its heavy ships, the protection of the planes observing this gunfire is placed ahead of the protection of the capital ships themselves, particularly as by maneuvering and by antiaircraft gunfire, these vessels are, to a certain extent, capable of protecting themselves.

The second of these missions, that is, the protection of the capital ships themselves from aërial attacks, involves offensive action against the hostile aërial striking force and its escort of fighting planes. The third and last involves the protection of the tactical scouting planes from hostile fighters.

This scouting group undoubtedly will be the first group to take off from the carriers, perhaps immediately upon the receipt of contact with the enemy main body. Its duty is to make and maintain contact with the enemy main body as soon as practicable and to keep the commander of its fleet informed of tactical developments such as deployment, course and speed of the enemy, etc. While a portion of this information can be obtained from surface vessels of the screen and from the observation planes, yet earlier and more complete information than is available from these sources is essential, as witness the uncertainty of Admiral Jellicoe at the Battle of Jutland with regard to his deployment, until just before the ships under his immediate command made contact with the enemy. He himself stated that had he been in possession of more accurate information he could have deployed to better advantage. Had he been in possession of an aërial scouting force as suggested, this information would have been afforded him. As such information is more reliable when coming from an officer of considerable tactical experience, this scouting group should carry in an observing capacity at least one officer of sufficient experience to enable the commander in chief to have confidence in his advice on tactical dispositions—as, for example, the chief of staff of the commander of the aircraft squadrons or a flag officer particularly detailed for such duty.

The main aërial portion of the engagement, however, will be between the fighting planes of the offensive fleet and the aërial striking force of the defensive fleet plus its escort. Past experience in aërial maneuvers seems to indicate that the groups involved will maneuver as separate squadrons or formations, of from nine to eighteen planes, with the individual squadrons attempting to coördinate their efforts. Each squadron of heavy planes will probably have the protection of at least one squadron of fighting planes despite the fact that a *formation* of heavy planes has a certain inherent ability to defend itself against aërial attack, particularly so in the case of torpedo planes when close to the water. In this latter case

hostile fighters are hindered in diving, their usual form of attack, as they must start recovering from such dives well before reaching the altitude of the low-flying torpedo planes in order to avoid "squashing" into the water. In addition, the proximity of the water insures the torpedo planes from attack from beneath, which covers their greatest point of vulnerability due to blind angles.

In any event, fighters intending to attack heavy planes must themselves be provided with protection from the escort of such planes. The general aërial battle will therefore resolve itself into a number of smaller conflicts with, generally speaking, a squadron of heavy planes plus a squadron of fighters opposed to two squadrons of fighting planes. Additional squadrons of any or all types may be added on either side but in no case would a single squadron of fighters be justified in attacking a formation of heavy planes, except in the absence of protective fighting planes or of any consideration requiring their continued existence.

A more detailed discussion of aërial tactics is beyond the scope of this paper but before dealing with the second type of naval engagement, the following general observations are in order. First of all, the commander of the offensive fleet will not be justified in continuing the action once the control of the air has been definitely obtained by the enemy, unless the hostile surface fleet is at the point of being annihilated. Second, it is incumbent upon him, except under similar circumstances, to break off the action in the case of the loss of all or a great majority of his aircraft carriers. Third and last of all, if the issue remains in doubt, he must discontinue the action before his aircraft have exhausted their fuel supplies—in the case of the existing types of fighting planes, a period of not much over two hours.

This last assertion merits detailed discussion particularly as it might be argued that the defensive fleet would be faced with a similar problem. Such is not the case, however, as the shore-based planes of the defensive force may be dispatched in waves, the surviving planes of which may withdraw from time to time for refueling and rearming. The aircraft of the offensive fleet, being inferior in numbers, must be maintained at full strength at the theater of operations in order that the command of the air may not be lost definitely. While it is possible for fighting planes to carry fuel for as long as five hours or even longer, such additional fuel capacity can be gained only at the expense of performance which, in this type, would be fatal to their efficiency. Consequently the commander of the offensive fleet must discontinue action, if the issue is still in doubt, not much later than two hours subsequent to the launching of his fighting planes from their carriers, unless he is willing to concede the control of the air to his opponent.

From the standpoint of the defensive fleet, aërial tactics are in general similar to those for the opposing force but with certain additions. As previously mentioned, its numerical superiority in aircraft permits it to launch an aërial attack in sufficient numbers to contend seriously for aërial mastery and still retain a reserve which, if launched at a later time, will enable it to continue the action for a longer period, with less risk of losing control of the air, than can the offensive fleet.

Certain types of aërial attack not previously mentioned are available. First of these is an aërially laid smoke screen as a preface and an aid to a torpedo attack, either by small surface craft or torpedo planes, or both in conjunction. If laid by fast planes, an excellent smoke screen can be placed in a very short space of time without the expenditure of any large amount of military strength. Under the cover of such a screen, a torpedo attack, particularly if made by aircraft, would constitute a serious menace.

Seldom discussed, but nevertheless worthy of consideration, is the possibility of a diving bombing attack on capital ships by fast planes armed with bombs filled with chemicals instead of explosives. While certain nations have mutually agreed to prohibit the "use in war of asphyxiating, poisonous or other gases, and all analogous liquids . . . ."[1] not all of the nations have agreed to this prohibition. Judging from the past, it is within the realm of possibility that, in the extremity of desperation, some nation might disregard such an agreement or argue that this wording does not prevent the use of gases that are incapacitating rather than

[1] Section V of the Washington Limitation of Naval Armament Treaty.

deadly in their effects. Even the use of chemicals that are lachrymatory or otherwise temporarily disabling rather than definitely toxic in effect, affords a means of attack that merits grave consideration. A single formation of planes armed with bombs of this nature might conceivably put a capital ship out of action by the disablement of its personnel, even though the ship itself remained undamaged materially.

A discussion of the day engagement under lowered visibility conditions is now in order. Such a discussion might be prefaced by one of the various kinds of such weather conditions. These may be classified in four general types. The first is reduced horizontal visibility at the surface accompanied by good visibility in both dimensions aloft; the second, reduced visibility both horizontally and vertically; the third, which is of rare occurrence, good horizontal visibility accompanied by reduced visibility vertically; and the last, generally poor visibility.

Under the first two types of reduced visibility conditions, planes can generally sight the surface vessels well before they themselves become visible. Hence, under such conditions, an aërial striking force is at its maximum efficiency due to the decreased ability of surface ships to defend themselves. Consequently, in such cases, the command of the air is of relatively greater importance. With reduced horizontal visibility at the surface accompanied by good visibility aloft, an aërial striking force is concealed from surface vessels until just prior to the delivery of its attack. Fairly often, under such conditions, the first indication of the presence of hostile aircraft in the vicinity is manifested to the surface craft by the results of the attack. Although the engines of the planes may be heard their locations remain undisclosed. Surface craft are frequently visible to the aircraft when the reverse is not true. On one occasion during maneuvers the horizontal visibility was about 3,000 yards at the surface. Overhead was a layer of clouds about 2,000 feet above the surface. This cloud bank was broken sufficiently so that no serious difficulty was experienced in making an approach on the surface vessels preparatory to a heavy bombing attack. As the planes flew comparatively close to the upper limit of the cloud layer they were disclosed to the surface vessels only momentarily. If observed at all, they were seen only for a few seconds and would then disappear. Certainly little could have been done from the surface to impede the attack.

Under these circumstances, a group of torpedo planes could have located their objectives and maneuvered to gain the position for launching their attack while remaining above the cloud layer, and then descended and delivered their thrust, almost before the surface vessels could have opened fire.

On another occasion only the tops of the battleships could be seen from the air—quite sufficient for the bombing planes but very unsatisfactory for the surface vessels. Other actual instances might be added but these suffice for illustrative purposes.

When the visibility is reduced both vertically and horizontally, the aërial striking force has its greatest chance of success, provided only that the visibility is not so low as to prevent or hinder it from locating its objective. The chance of evading hostile aircraft altogether is excellent and the inherent defensive ability of surface craft is impaired. While the attack itself may not be launched quite as efficiently as under better weather conditions, still it is quite probable that a larger percentage of the planes attempting the attack would survive to deliver their blow. Fighting planes, under such conditions, must remain in, or nearly in, sight of the surface vessels they are guarding and frequently will not be in a position to launch an attack upon hostile aircraft immediately upon sighting them. Under these conditions, heavy bombing attacks may be greatly impeded if not rendered altogether impossible. On the other hand, an attack by torpedo planes has a greater chance of success.

If the third type of visibility conditions is encountered, that is, good horizontal accompanied by poor vertical visibility, the heavy bombing attack (which must be delivered from an altitude) is impracticable. Torpedo plane attacks will be quite possible. Under these conditions, the planes probably will be flying very close to the water, in which position they are least vulnerable to attack from hostile fighters. If preceded by smoke-laying planes and accompanied by a fighting plane escort, they would have an excellent chance of pushing home their attack despite aërial and surface resistance, particularly if they should ascend into the clouds after locating their targets and then

did not descend until just prior to delivering their attack on the disengaged bows of the ships they were attacking.

In the last type of conditions, that is, reduced visibility in all directions, the effectiveness of aircraft would be dependent almost solely upon their ability to locate their objectives before they came too close to deliver an efficient attack. With the modern planes flying at 200 feet per second (120 knots) and faster, a considerable distance is covered by the time the pilots are able to identify the surface craft sighted as belonging to the enemy forces and deciding to attack. Arbitrarily, we may consider that if the visibility is much below 1,000 yards a successful aërial attack on surface vessels is purely a matter of luck. While bombing under these conditions would be almost impossible, torpedo plane attacks might (the visibility being assumed to be 1,000 yards or greater) be delivered with little or no aërial opposition. The chance of evading protective fighting planes is excellent and gunfire can do little to impede such an attack. On the other hand, the attack probably would not be well coördinated.

Generally speaking, in a day engagement under reduced visibility conditions, aërial observations of gunfire and aërial tactical scouting would be of relatively lessened efficiency and consequently of lesser importance. In fact, except for the increased menace of an attack from bombing or torpedo planes, a naval engagement of this type would have the same general character as an engagement under similar circumstances prior to the introduction of aircraft within the fleet. Due to the increased potentialities of the aërial striking force, an engagement under these conditions would be avoided by the offensive fleet and sought for by the defensive fleet.

In the case of a night action, conditions are quite different. Here, speaking from an aërial standpoint, the offensive fleet is at a great disadvantage. First of all, the results of such an action can hardly be conclusive and consequently it is incumbent upon the commander of such a fleet to conserve his aërial strength. If he launches his planes a large percentage will probably fail to return due to their inability to relocate their carriers prior to the exhaustion of their fuel supplies. The carriers can do little or nothing to aid the planes in this respect without exposing themselves to hostile aërial attack. If they exhibit lights the enemy will be aided in locating them as well as their own planes. If radio is used for this purpose much the same risk is incurred.

If the carrier planes of the offensive fleet are not launched, an attack from the aërial striking force of the opposing fleet, particularly from the bombing planes, can be delivered at little cost in aërial strength. Even if defensive fighters are launched it is by no means certain they could divert or otherwise impede the attack. The best possible course of action for the offensive fleet under such circumstances would be to retire at high speed.

From the standpoint of the defensive fleet, whose main objective is the attrition of the enemy surface strength, the opportunities afforded by a night action are ideal. As previously stated, the shore-based planes could deliver an attack on the surface vessels of the offensive fleet with only a slight expenditure of aircraft from hostile efforts. The location of the shore bases being already definitely known with more or less exactitude to the enemy, no harm would be entailed by the use of radio in guiding these planes back. Being beyond the range of the enemy, lights could be used without risk for this purpose, and to assist planes in landing. Consequently, few, if any, of the aircraft dispatched from shore bases would fail to return due to inability to relocate their bases.

In summary, the following general conclusions may be drawn from the premises previously enunciated. The difficulties inherent in the assumption of the offensive in a naval campaign have been considerably increased by the introduction of aircraft as an integral part of naval warfare. This will necessitate a greater preponderance of surface strength for the successful completion of the offensive mission than has been requisite heretofore.

As the larger nations lack such a definite superiority at present, under the limitations imposed by treaty, the necessary additional ships must be obtained by alliances or by naval construction subsequent to the declaration of hostilities. In the absence of such alliances, a period of comparative stagnation in the naval phase of the war must be expected, until one of the warring nations has been able, by new construction, to gain the superiority in surface strength es-

sential to the successful assumption of the offensive.

With this preponderance in surface strength, the logical and most efficient weapon for the fleet acting offensively is gunfire from surface craft, thus enabling it to dispense with an aërial striking force capable of reducing the enemy's surface strength. This elimination enables the fleet acting on the offensive to replace planes of these types with others capable of aiding in the defense of its surface craft from aërial attack. This will permit the offensive fleet to contend, with a better chance of success, for the command of the air with the necessarily numerically superior aërial forces of the enemy.

The fleet acting on the defensive, by virtue of its ability to supplement the planes carried within the fleet by planes based on shore, will have a superiority in total numbers of aircraft available. This superiority in aërial strength, coupled with the inferiority of such a fleet in surface vessels, makes aërial attacks on the surface strength of the offensive fleet its most logical weapon as an efficient means of attrition. For this purpose aircraft of types capable of menacing the safety of capital ships are required and it therefore follows that all types of aircraft capable of being carried on shipboard are essential within the fleet acting defensively.

Because of its numerical superiority in aircraft, the defensive fleet is enabled to maintain a sufficient force of planes in the air at the scene of a naval engagement to contend for the command of the air and at the same time have replacement planes replenishing their fuel and ammunition. This, unless the fortunes of the day have been definitely decided, would enable the defensive fleet to remain in action a longer period than the opposing fleet. The aircraft of the offensive fleet, being outnumbered, must remain in the air at the theater of operations in their total numbers. Hence, the time that such a fleet can remain in action, while still contending for aërial control, is limited to the time required for its aircraft to exhaust their supplies of fuel—a period which, at present, does not exceed two hours.

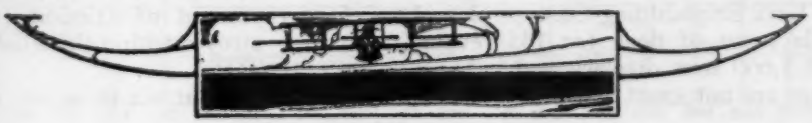
The bulk of the aërial strength of the offensive fleet being based upon aircraft carriers, the primary objective of the opposing aërial forces is the destruction of these vessels. If even a majority of these carriers are destroyed a further continuance of the offensive is unjustifiable. Therefore, these vessels must be protected at all costs from aërial attack, both by means of aircraft and by placing them well in the rear of the fleet.

In the event of failure to destroy the opposing carriers, the next objective of the defensive aërial forces is the reduction of the capital strength of the opposing fleet. If its carriers are safe, the mission of the aircraft of the offensive fleet is the protection of its capital ships from aërial attack.

In the day engagement under good visibility conditions, the difficulty of delivering a surprise aërial attack is at a maximum and gunfire is at its maximum efficiency; hence an action under these circumstances will be sought by the fleet acting offensively. Conversely, as the effectiveness of defense against aërial attack, whether by other aircraft or by antiaircraft gunfire, is decreased under lowered visibility and as the efficiency of surface gunfire is likewise reduced, an engagement under these conditions probably will be more advantageous to the defensive fleet.

The offensive fleet must avoid a night action, due to the necessity for conserving its aërial strength, because of the comparative inefficiency of surface gunfire under such conditions, and because of the dangers of a successful attack from the air.

Finally, no nation can be certain as to whether strategical or political considerations may require the assumption of the naval offensive or the acceptance of a defensive rôle. However, the application of these principles, due to the comparative ease with which carriers may be re-equipped with planes of other types, is in no wise inconsistent with a naval policy involving the development of all types of aircraft, provided that the training of the naval aviators involved is sufficiently diversified.



Time Out *of* Dock

By LIEUTENANT E. M. THOMPSON, *U. S. Navy*

IN MANY cases the effect of foulness of bottom on the power plant of the ship is not fully appreciated. In the first place there is no criterion by which the degree of foulness of a ship's bottom can be measured. The growth on the ship's bottom depends on the degree of excellence with which the bottom was last scraped and painted, length of time since last docking, operating conditions since last docking, and vicinity of those operations. The first is in the hands of the ship's personnel and the weather; the others depend entirely on the employment schedule. Since there is no definite measure of the degree of foulness of the ship's bottom, we will use the number of days since last docking.

There are three outstanding effects of time out of dock: First, reduced speed for the same number of revolutions; second, increased power necessary for the same number of revolutions; and third, a drop in vacuum due to a decreased amount of circulating water through the condenser. The decrease of speed will not be discussed here.

The greatest effect of the foul bottom is in the increased power required to make the same number of revolutions. Data pertaining to the effect of foul bottom were collected over a period of time from a squadron of destroyers operating on the Atlantic Coast. These data are given in the curves shown in Figs. 1 and 2. As it was impossible to measure the horsepower delivered by the engines due to lack of torsion meters, the power taken by the engines was measured by water rates. These were determined by the bowl pressure and the throat area of the nozzles used. The curve shown in Fig. 1 gives the water rate of ships of the New York Shipbuilding Co. type plotted against days out of dock for 135 revolutions and 1,660 tons displacement. These water rates are not exact but serve to show the trend of the curve and what may be expected. The shape of this curve is rather surprising but is checked by the curve shown in Fig. 2.

The curve shown in Fig. 2 is slightly different from that shown in Fig. 1, in that it shows the number of revolutions made, plotted against days out of dock, the engines having a constant water rate. The data for this curve were determined by using one nozzle and 250 pounds bowl pressure and observing the number of revolutions made.

The resistance offered the movement of a ship through water may be classified as follows:

(1) Streamline resistance due to the energy required to cause streamline flow in a liquid not entirely free from viscosity.

(2) Eddy or head resistance, due to the energy required for the maintenance of systems of large eddies of water in vortex motion.

(3) Skin resistance, due to the energy required for the maintenance of eddying water close to the skin of the ship.

(4) Wave resistance, due to the energy required for the maintenance of systems of waves which surround and accompany the ship.

In all cases (1) is relatively small and, in the case of a destroyer, (2) is also small. Most of the resistance then comes from (3) and (4).

Taylor suggests the following formula for the resistance of a ship moving through the water:

$$R = fAv^{1.83} + 12.5\,bDv^4/L^2$$

where

R = resistance in lbs.

f = coefficient of friction (for a destroyer with a clean bottom about .009).

A = wetted surface in sq. ft.

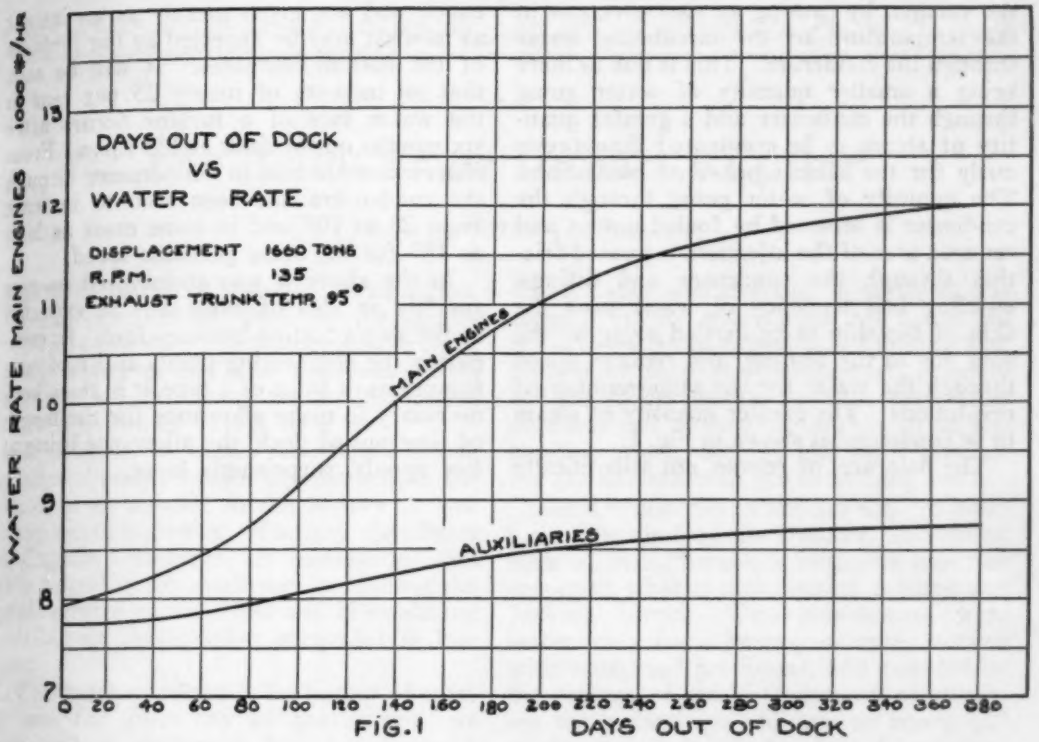


FIG. 1

b = block coefficient of fineness (for destroyers about .4).
v = velocity in knots per hr.
D = displacement in tons.
L = length in ft.

From this formula it will be seen that skin resistance is expressed in the first part of the formula and the wave-making resistance in the latter part. On analyzing this formula it will be seen that there are two variables, assuming displacement constant. The coefficient of friction (f) varies with time out of dock and the speed (v) is varied at will. At low speeds it will be seen that the increase in the coefficient of friction plays a large part in the resistance offered a ship moving through the water while at high speeds the wave-making energy becomes the controlling factor.

The length of time out of dock affects

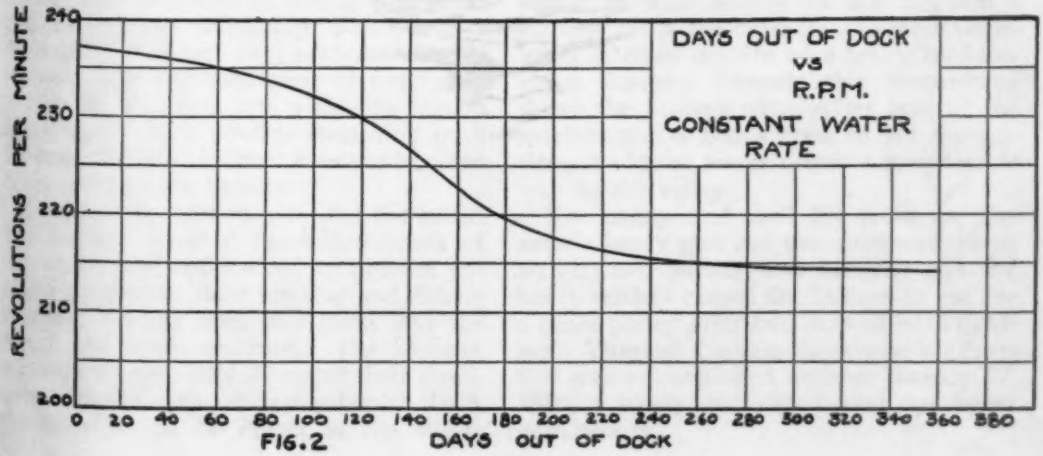


FIG. 2

the vacuum by causing an excessive rise in the temperature of the circulating water through the condenser. This is due to there being a smaller quantity of water going through the condenser and a greater quantity of steam to be condensed than previously for the same number of revolutions. The quantity of water going through the condenser is lessened by fouled scoops and reduced area of the injection, increased friction through the condenser and fittings, swirling and tendency of water near the skin of the ship to be carried along by the ship due to the fouling, and reduced speed through the water for the same number of revolutions. The greater quantity of steam to be condensed is shown in Fig. 1.

The data are, of course, not scientifically exact, and are given merely as an insight as to what may be expected as the foulness of the bottom increases. It will be seen that an increase of nearly 25 per cent in the water rate of a turbine occurs after six months out of dock at 135 r.p.m. From observation the rise in temperature through the condensers has been seen to increase from 2° to 10° and in some cases as high as 18° for the same previous speed.

In the above it was endeavored to give roughly an idea of what may be expected as the ship's bottom becomes foul. In comparing the engineering plants and fuel consumptions of ships of a type, it is, then, very necessary to make allowance for the length of time out of dock, the allowance being at low speeds, surprisingly large.

The Navy *as an* Indian Fighter

By Colonel John H. Brandt

THE battle of Seattle, Washington, October 26-28, 1855, is not generally known. The history of the U. S. Navy is full of brilliant achievements on land and sea, but many are not chronicled or even known of except by a few.

This battle, in which the United States gunboat *Decatur* fought against hostile Indians, is an episode in the history of our Navy worth recording. Through the efforts of Captain Gansvoort, her commander, this ship helped in no small way in making the great empire of the West and in rendering possible an immigration unequaled in history.

This battle occurred in the harbor of what is now the great city of Seattle with its half million inhabitants, but at that time a struggling village of perhaps two hundred people, congregated together for mutual protection and interests. In the valleys beyond, the more adventurous men and women had taken up land for agricultural purposes. Bands of stalwart pioneers had hewn out of the wilderness little towns.

In those days ships of war like the *Monitor* or *Merrimac* were unknown, not even thought of. Who in those thrilling days would have dreamed of seeing that great and magnificent battleship *California,* a floating fortress and city, anchored in that harbor? The bay then came up over what is now the tide flats into a shallow lagoon nearly closed by a sandbar stretching from the present Fifth to Third Avenues between Main and Jackson Streets.

Considerable friction preceded the battle. The Indians resented the advancement of the whites and endeavored to prevent encroachment upon their hunting and fishing grounds. White men had gone into the forest and never returned. The Indians, when questioned, only shrugged their shoulders. On the night of September 27, 1855, the home of A. L. Porter in the White River Valley was attacked. Luckily he was sleeping in the woods near his house but the savages, disappointed in not finding him, burned the house and its contents. Friendly Indians had crept into the little town after darkness and notified the settlers of an impending attack, thereby making it possible for the defenders to get everything ready.

The *Decatur* lay in the harbor. A howitzer, furnished by the *Decatur,* was placed back of Mr. Plummer's henhouse near the corner of what is now Second Avenue and Jackson Street. Two blockhouses were made ready for a lengthy defense, stocked with water and provisions, and guarded by the settlers. Captain Gansvoort, after taking the women and children on board and placing them below decks, cleared for action. The settlers of the valley fled to Seattle.

During the night of October 27, 1855, war whoops were heard in the valley, and by daylight the next morning eight white persons had been killed and a baby had disappeared. To this day the fate of the child has never been solved. There is a legend that he grew up among the Indians, a white man in features but a savage in manners.

The muskets of Indians hidden in the timber of what is now the first hill sent a rattling fire at the defenses. Captain Gansvoort directed the fire of a heavy howitzer using shrapnel towards this timber and drove the Indians out. After landing the marines and a boat's crew to aid the settlers, the Indians were driven a considerable way up the valley.

The unexpected shell fire from the *Decatur's* heavy gun and the counterattack by well-trained sailors and marines and the hardy settlers caused the Indians to ask for a peace parley after two days of hard fighting. Through Captain Gansvoort's efforts this was accomplished and on January 27, 1856, a treaty was sealed that has never been broken.

Coöperation *of* Air Forces *in* Coast Defense

By COMMANDER R. D. WEYERBACHER *(C.C.), U. S. Navy*

THE line of demarcation between Army and Navy effort in joint coastal operations was definite prior to the advent of aircraft. Functions involving sea operations were inherently naval while those involving land operations were, by the same tokens, inherently army, and the coast was always there as a tangible dividing line. Airplanes, however, are capable to a certain extent of operating over either element and herein lies the possible source of much confusion in joint operations, resulting in the possible creation of a "twilight zone" of divided or overlapping authority and responsibility.

At present the Navy operates patrol and scouting aircraft from shore in connection with the protection of sea lanes. The Army operates aircraft from shore bases for all other purposes. Airships, in the following discussion, will not be considered, for it is now recognized that, so far as operations over the sea are concerned, they are a part of the fleet, although they operate from shore stations in a manner similar to the surface vessel.

It is believed that the only real controversy between the Army and Navy concerning air components is over bombardment and pursuit aircraft to be used in defending this country against an enemy approaching over the sea. The question is: who is to provide and control the bombing and pursuit aircraft that will operate from land bases and fly out over the sea to the limits of their cruising radius? If this point is definitely settled, there will be no further controversy.

The following extract is from the hearings which took place before the Lamport Committee:

Major General Patrick: "Once the decision is made to place upon the air corps the development and utilization of air power as a primary function, there should follow immediately a solution of the vexing problem of air coast defense. The pro and con of the propriety of assigning this function to either the army air service or the naval air service has been studied and discussed at length. Without entering into discussion of the ways and means at present provided to solve this problem, the plain fact remains that there is an undeniable duplication of coastal air facilities in the United States and in its possessions. The creation of an air corps primarily as an air-going combat unit should remove this question from a consideration of whether the air service of the Army or the air service of the Navy should be charged with operations in this "twilight zone" which includes the water area within reach of air operations conducted from land bases. I have no hesitation in saying that the assignment to the air corps of all air coast defense functions which can be performed from land bases (the limit to be taken at about 200 miles under the present state of aircraft development) will be one of the most important and immediate economies, and one of the greatest gains to efficient national defense which will result from the formation of the air corps."

Mr. Faust: "It is your opinion, I gather, that this coastal defense belongs rather to the Army than to the Navy."

Major General Patrick: "I think beyond question that the Army air components, no matter how it may be constituted, whether as at present a part of the War Department, or whether it be established as an air corps, can and should undertake the air defense of our coasts."

I have quoted Major General Patrick in order to give the opinion expressed by the Chief of the Air Corps at that time, and which is still the opinion of a great many members of the Air Corps, as well as other air enthusiasts.

The coast defense is now under the control of the Army. Aircraft may be called "bullets with wings." The Army claim of having control of aircraft operating from shore bases for offshore purposes, other than for the protection of our sea lanes, is based on the fact that they now have charge of the coast defense and, therefore, they should have aircraft which increase the range of their guns from yards to miles. This claim at first may seem to be justified but no conclusion should be drawn until in-

vestigation has been made as to the type of planes most suitable to perform this function and the personnel required to operate them. The claim that the Army should be responsible for the area 200 miles or any other number of miles from the coast merely shifts the "twilight zone" so many miles seaward. With increased range of aircraft this zone shifts farther and farther from shore and over the high seas until it reaches the point of absurdity. In an emergency who would be in command and who would be responsible in this zone when this new weapon is to be used? The last war again demonstrated the importance of unity of command, but it took months before it was accomplished. If one organization is responsible the chance of success is increased. If a change in responsibility is necessary, it should be made where it will do the least *harm;* that is, as far as possible from the first line of defense where it is most essential that command be unified.

The fact that the Navy is permitted to have aircraft operating from shore stations for protection of the sea lanes is not questioned. It is recognized that for the Navy to carry out this important function it must have all the facilities under one command. The responsibility with the necessary authority must be lodged in a single organization.

To obtain a logical solution it seems to be self-evident that an analysis should be made of the types of aircraft that are best suited for operating from shore stations over the water, and the type of personnel required for operating these types. The country demands most efficient material and personnel at least expense. After we have determined the kind of material and its operating personnel, we can then determine the type of organization, bearing in mind that unity of command is of vital importance and that responsibility and authority must go hand in hand. With the proper organization duplication of effort will be minimized with resulting economy.

The following are the general uses of aircraft operating from shore stations: To assist in (1) maintaining sea lanes; and (2) defeating enemy attack from beyond our coast line. The part that aircraft can play in this will, to a great extent, depend upon effective range. The greater the range of our aircraft, the greater is the distance that our offshore offensive can be started, and the greater distance at which our sea lanes can be protected by aircraft. Greater range, therefore, gives greater protection.

The first problem is truly a naval problem and there is no controversy.

Under the second problem, the controversy still rages. To defeat effectively aircraft attack from the sea you must destroy the enemy bases and, if possible, before the first attack is launched. Such an attack once launched is difficult to find and destroy since aircraft can operate in three dimensions and attack may come from any direction. This is especially so for night attack. Even assuming that an attack is launched, it is almost as essential to destroy the bases. The aircraft attack is then at end except for the first flight.

Therefore, to protect our shore line we should destroy the enemy aircraft floating bases as far as possible from our coast line. If the aircraft operating from shore can destroy the enemy aircraft carriers offshore at a distance greater than the range of the enemy aircraft operating from carrier or floating bases, the conclusion is that no enemy aircraft can attack our coast. Let us consider what type of plane is best qualified for this long-range offense. In this discussion it is, of course, assumed that the fleet and all carriers are otherwise occupied; in other words, that this is purely a coast defense problem.

Contrary to the general opinion which has been expressed in former hearings on this subject, the flying boat is a most efficient load-carrying machine; in fact, it is now generally accepted as more efficient; i.e., it has a greater percentage of useful load than the landplane of the same gross load, and the greater the size of the plane the greater the load-carrying efficiency. The reason for this is that the flying boat has a greater allowable take-off and landing speed, since it operates from and to an unlimited aërodrome, and hence has a greater allowable loading. To be specific, patrol planes now in use by the Navy are capable of carrying two 1,000-pound bombs 1,000 miles and return under service conditions.

Since the flying boat operates over water it is safe in the event of a forced landing, whereas the landplane will sink in a short period of time, if not immediately. Under certain conditions, if repairs can be made,

the flying boat can again take off. Such long-range bombing and scouting coast defense problems as described above should be carried out in peace time for practice, and in connection therewith the American people demand that danger to our operating personnel be reduced to a minimum. By the use of the flying boat this object is gained in time of war as well as in time of peace, and with the same type planes. Moreover, the flying boat can be developed into an aircraft carrier capable of carrying a complement of fighting planes, thus increasing by several hundred per cent the effective range of present fighting aircraft for the purpose of gaining control of the air and defense of bombing attack. After launching the fighting aircraft from the flying boat carrier, the latter can perform patrol functions and, if neccessary, can later pick up the pilots from the fighting planes when they have executed their mission. As a possible alternative to the above, large flying boats can be used for the purpose of accompanying and refueling fighting planes taking off from land bases. However, the impression must not be gained that the above operation is confined to aircraft, for the attack will be conducted by aircraft, surface craft, and sub-surface craft simultaneously. As previously mentioned, in order for this attack to be successful it must be coordinated under one command and it should be noted that all the types of vessels and aircraft used are the same as now used or contemplated for regular naval operation.

If enemy aircraft and ships evade, wholly or in part, the first line of defense as described above, and get in closer to the coast, a supplementary line of defense can be established by small, light, fast airplanes of the fighting and light bombing class operated from shore bases. The attack of these aircraft must, of course, be coördinated with the pursuit from that part of the first line of defense which remains and with surface and sub-surface craft against enemy surface craft as well as aircraft. It should be clear that there must be no shift of command or responsibility between these two phases of the defense. The "twilight zone" must be pushed back to the shore line where it will do the least harm.

Since the first and by far the most important action in coast defense is to be over water, and since the attack is principally against surface craft (attacking enemy aircraft being of secondary importance, and not necessary if we destroy the enemy aircraft carriers far out at sea), we require personnel who are also familiar with ships and who are experienced in seamanship, as well as trained aviators. It is evident that the type of personnel required is *naval personnel.*

Since the Navy must have aircraft for use in connection with the protection of the sea lanes, and since these types of airplanes can, in general, be the same as the types required for fleet work, it seems that, from the standpoints of effective organization, unity of command, and prevention of duplication, there is only one logical solution: to place all aërial coast defense under one control, and that is the Navy.

Therefore, the line of demarcation between the activities of the Army and Navy should not be at sea but at least at the shore line, as it was before the advent of aircraft. If the Navy is given the responsibility and authority necessary to the protection of our coast by the operation of aircraft from shore bases, we will have unity of command and no enemy will gain a foothold on our soil.

Coast Defense

Let us consider this problem in the following manner:

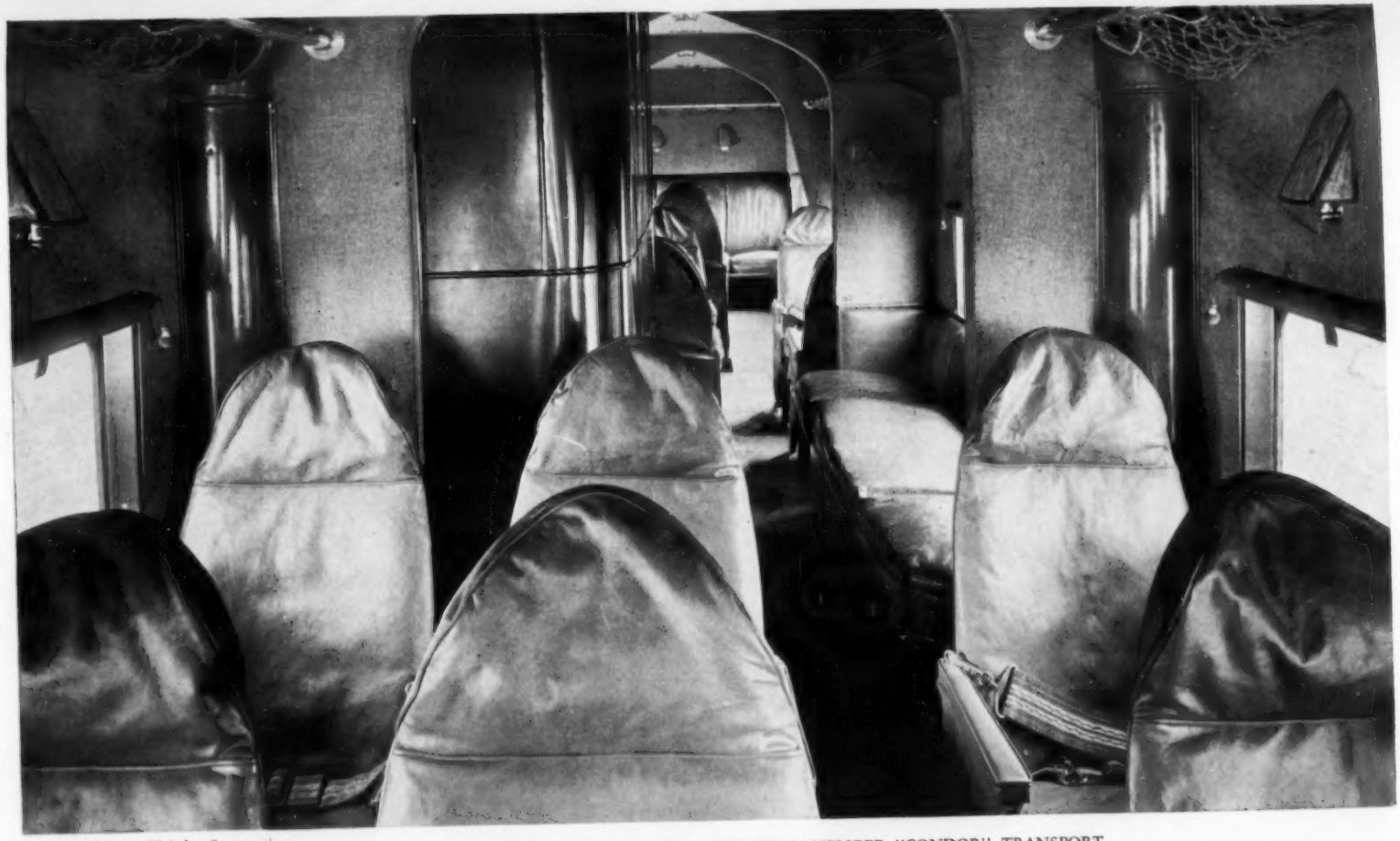
(a) What is to be done? Protect our coast line from air attack.

(b) How is this to be done? By destroying the enemy aircraft carriers at sea at a distance greater than the enemy aircraft can launch their attack against our coast.

(c) Where is the attack to be made? At sea.

(d) What means are necessary—material and personnel? Since the attack is primarily against aircraft carriers, the most efficient long-range aircraft, and personnel who are familiar with ships and who have a knowledge of seamanship are necessary. The most efficient ship is the flying boat for long range and the most efficient pursuit type of aircraft is that which can drop its landing gear.

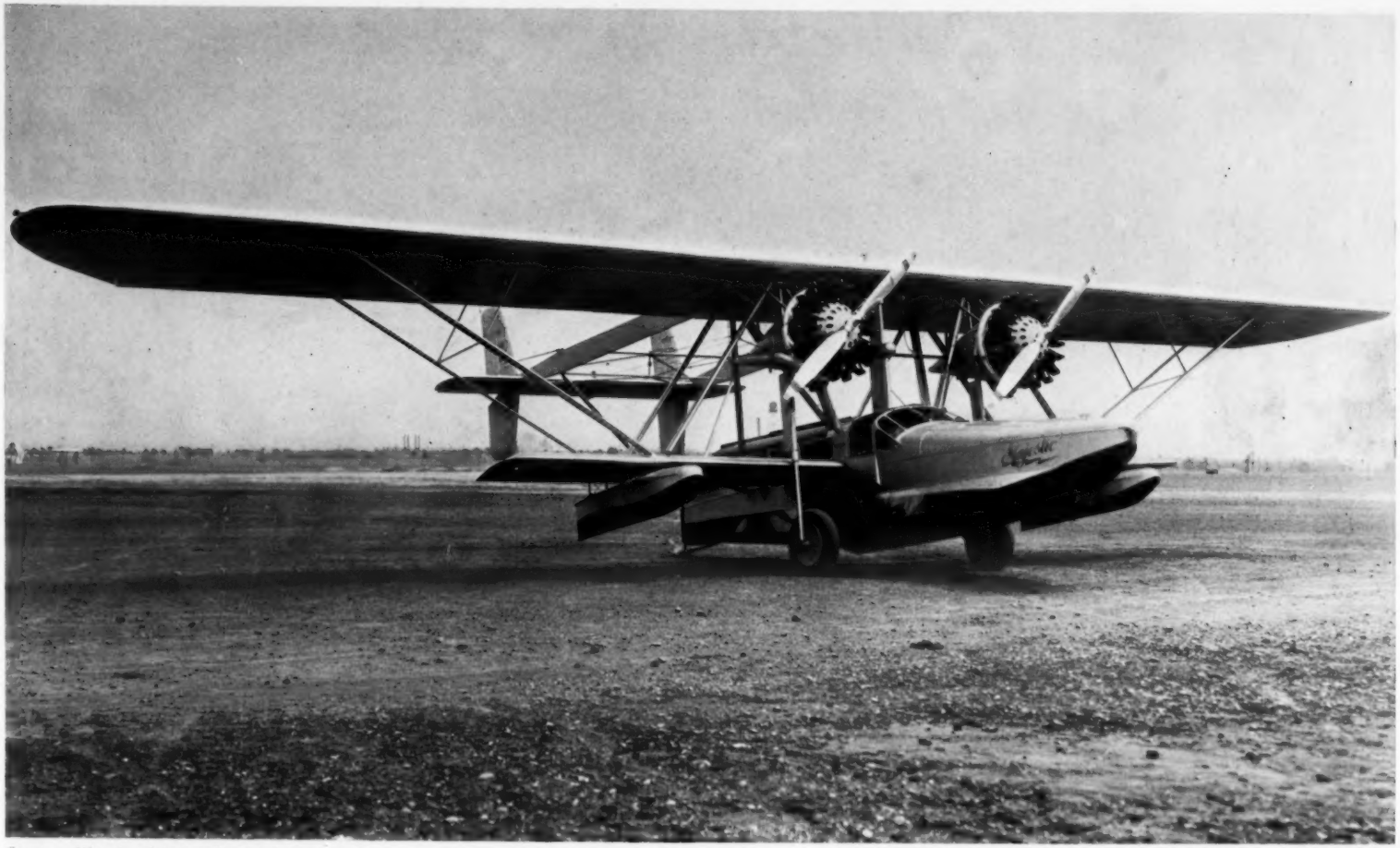
(e) How is it best to accomplish the above? It is self-evident that the Navy can best perform this mission.



Courtesy Curtiss-Wright Corporation

INTERIOR VIEW OF THE LATEST CURTISS TWENTY-PASSENGER "CONDOR" TRANSPORT

This is powered with two geared Curtiss "Conqueror" 600-horsepower engines. It is in use in transcontinental air transport.



Courtesy Sikorsky Aviation Corporation

SIKORSKY S-38

The ten-place amphibion, the *Majestic,* owned by Grigsby-Grunow Company of Chicago, makers of Majestic radios.

International News Photos, Inc.

THE HELICOPTER, WHICH MAY REVOLUTIONIZE INDUSTRY

The Curtiss-Wright helicopter is now nearly completed and will soon undergo a series of tests. The design of Maitland Bleecker, the machine resembles the de la Cierva autogyro outwardly. One fundamental difference is that the Bleecker wings are made to revolve by the pull of their propellers, whereas in the autogyro the rotation of the wings is a result of the forward motion of the entire machine.

Courtesy Consolidated Aircraft Corp.

NAVAL PATROL MONOPLANE FLYING BOAT—CLASS XPY-1

This flying boat was the result of a design competition open to the American aircraft industry, and was awarded to the Consolidated Aircraft Corporation of Buffalo.

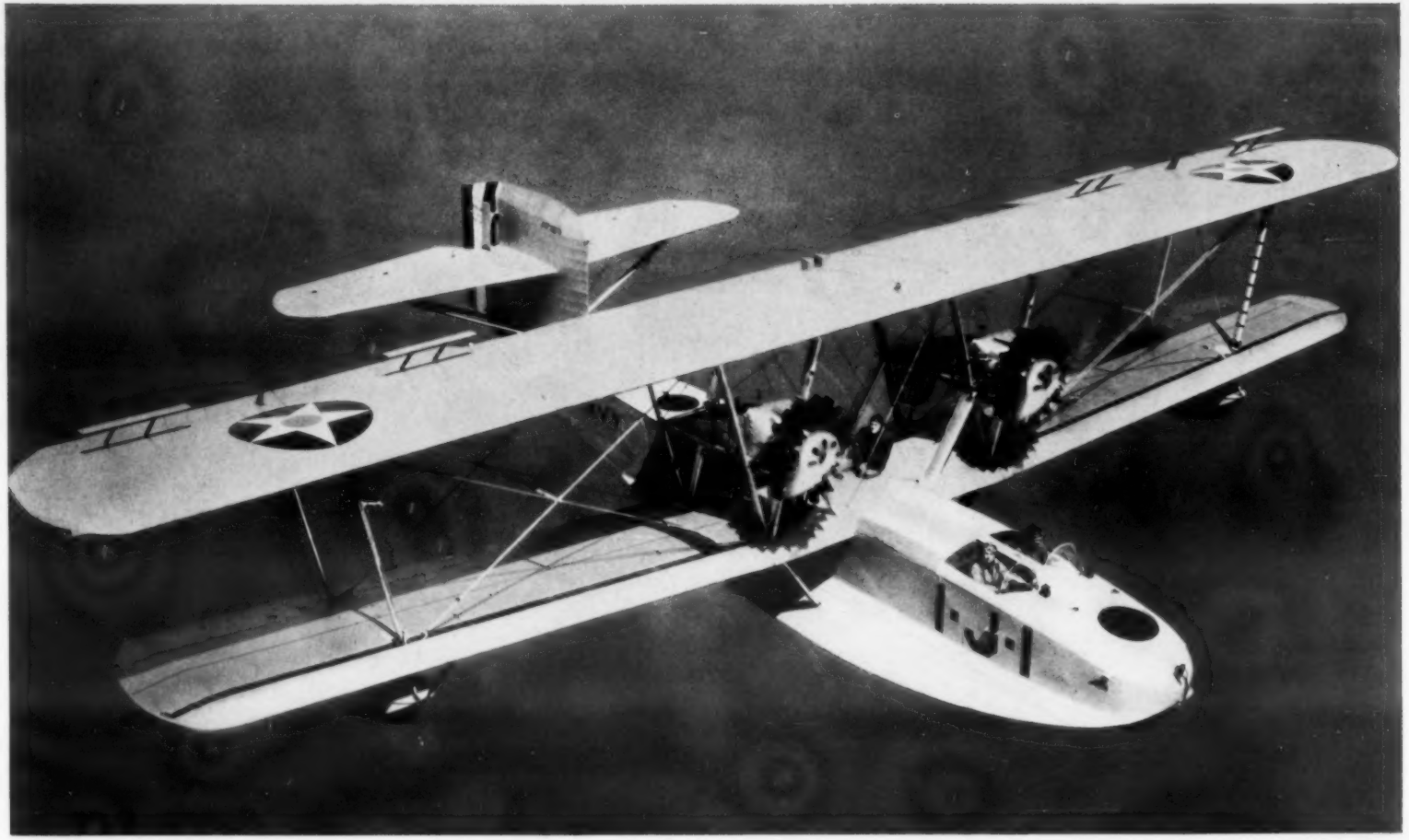
This flying boat was the result of a design competition open to the American aircraft industry, and was awarded to the Consolidated Aircraft Corporation of Buffalo.

UNIV. OF MICH.

Courtesy Glenn L. Martin Company

PM-1'S, NAVAL PATROL FLYING BOATS, UNDER CONSTRUCTION BY THE GLENN L. MARTIN COMPANY

The finished product will be similar to the *PN-12*. Construction of the hull is started in the upside-down position.



Courtesy Pratt & Whitney Aircraft Company

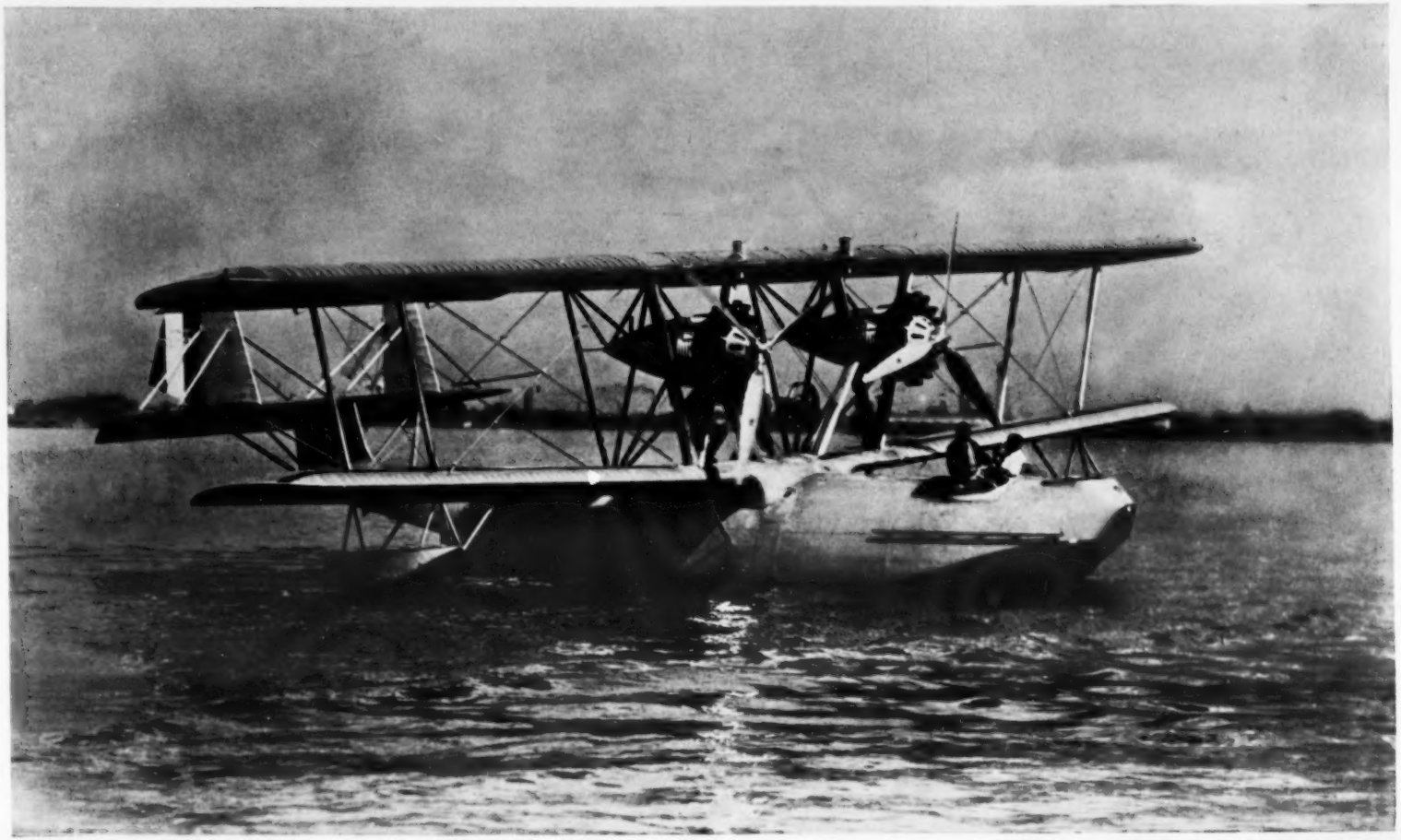
NAVAL PATROL HEAVY BOMBING FLYING BOAT—CLASS PN-12

This flying boat is powered with two "Hornet" engines and has established six world's records.

Courtesy The Glenn L. Martin Company

PM-1, NAVAL PATROL AND FLYING BOAT, IN THE PROCESS OF CONSTRUCTION AT THE GLENN L. MARTIN COMPANY

UNIV. OF MICH.



Courtesy Lieutenant J. F. Gillon, U. S. Navy

PN-11 NAVAL PATROL FLYING BOAT
This was constructed by the Naval Aircraft Factory.

Naval Patrol *and* Bombing Flying Boats

By LIEUTENANT JOHN F. GILLON, *U. S. Navy*

THE near future will see the completion of more than fifty large patrol flying boats for the U. S. Navy. It seems timely, therefore, to describe the operation requirements, construction, and desirable basic features of this important type.

Briefly, the flying boat is made up of the main body, or fuselage, which is merged into the hull. The wing structure is attached to and supported by the hull. The tail unit is secured to or integral with the stern. The engines are suitably disposed between or above the wings. The type is essentially restricted to operations from the surface of water and cannot be converted into a landplane. The fact that it must be seaworthy as well as airworthy causes many compromises in design.

Of the many complex problems which enter into flying-boat design, there are none so formidable, perhaps, as those which pertain to seaworthiness, an essential feature which should be obtained without undue sacrifice of other desirable characteristics. To be seaworthy, the flying boat must have freeboard, water-tight subdivision, and ample reserve buoyancy. It must also have the ability to rise quickly from the water. It should be stable and maneuverable under all conditions of surface operation.

On the other hand, to be airworthy, the flying boat must have minimum weight, minimum size, and lowest possible air resistance. Furthermore, it must be easily controlled and maneuvered in the air.

The structure, in spite of the light-weight requirement, must be rugged enough to withstand moderate seas and hard usage. The material should stand up under the harmful influence of salt water. Accessibility and ease of repair are essential. The power plants must be reliable and efficient. The arrangement of the cockpits for the operating personnel must give the maximum field of vision and arc of gunfire.

The foregoing are some of the considerations which confront the flying-boat designer. The final product under construction for the naval air service is, however, a seaplane with many good performance characteristics. The majority of these new patrol seaplanes are similar to a type that was developed by the Naval Aircraft Factory, namely the PN-12. The material used in this flying boat is practically 100 per cent metal, as compared with wood of former years.

One of the reasons for changing from wood to metal was the growing scarcity of suitable wood for aircraft construction and a second was hull soakage. The latter caused serious reduction in performance. Metal is non-hygroscopic. It is also manufactured and treated by exact processes, is capable of exact analysis, is homogeneous, and its strength can be relied upon within closely predicted limits. Moreover, it is non-combustible, better suited to use in extreme climates, and is easy to work into irregular shapes.

The metal used is an aluminum alloy, duralumin, which meets the requirement of maximum strength to weight ratio. At highly stressed points, alloy steel fittings are used. There has been one important factor which has retarded the general acceptance of metal for flying-boat construction and that is its susceptibility to corrosion. This is being successfully combated by subjecting the duralumin to the anodic treatment and by applying to the surface a protective coating of iron oxide primer, aluminum bituminous paint, or Navy gray enamel. The anodic treatment consists essentially of immersing the duralumin in a chromic acid solution, through which an electric current is passed. A very thin film with excellent adhesive properties is formed on the surface.

The materials and general design requirements of the patrol plane having been briefly

This was constructed by the Naval Aircraft Factory.

treated, the actual construction and layout of the PN-12 will be outlined.

Type. Two-engine patrol and heavy bombing flying boat: naval class designation, PN-12.

Wings. Unstaggered biplane. Top and bottom center sections interconnected by a triangulated system of steel tube struts. Extremities of lower inner wing braced to hull by two parallel steel tube struts. Outer wing sections each have one pair of widely splayed inter-plane struts at the base of which are metal wing-tip floats. Spar and rib construction is of duralumin with fabric covering. Ailerons are installed on the upper wing only and have auxiliary balance surfaces.

Hull. All-metal, two-step, V-bottom type; quite similar to the F-5-L in lines. The keelson, the longitudinals, and the transverse frames are of duralumin, with alloy steel fittings at highly stressed points. Four transverse water-tight bulkheads divide the hull into separate compartments. The outer shell consists of duralumin sheet, riveted to all constructional members with duralumin rivets.

Tail unit. Monoplane type, duralumin framework, and fabric covering. The stabilizer is adjustable from the pilot's cockpit and the rudder has auxiliary balanced control surfaces.

Power plant. Two 525-hp., Wright Cyclone, R-1750 D, air-cooled, radial engines. Main fuel tanks (six) located amidships in the hull aft of the pilot's cockpit. Oil tanks are located in the cowling aft of each engine.

Special features. Crew of five is carried. The navigator-bomber's cockpit is in the nose, with a flexible machine-gun mounting. This cockpit is also equipped with bomb sights, navigating instruments, and folding chart board and serves as the stowage place for the anchor and line. Immediately behind is the open pilot's cockpit, seating two side by side, with dual bridge control and instruments for each pilot. Next is the fuel compartment, followed by the gunner-mechanic's station. The radio compartment is farther aft, followed by the after machine-gun station.

Dimensions. Span, upper wing, 72 ft. 11 ins.; lower wing, 67 ft. 2 ins.; height 16 ft. 4 ins.; length 49 ft. 2 ins.; total wing area, 1,162 sq. ft.

Weights and loading. Weight empty, 7,453 lbs.; useful load, 6,669 lbs.

Performance. Maximum speed, 114 m.p.h.; stalling speed, 58 m.p.h.; service ceiling, 10,900 ft.; range at cruising speed, 1,300 miles.

This patrol flying boat is under quantity production for the naval service by the Glenn L. Martin Company of Baltimore and will be classified as the PM-1. There will be, however, many desirable changes incorporated in the boat under construction.

The Keystone Aircraft Corporation of Bristol, Pa., and the Douglas Aircraft Company, Inc., of Santa Monica, Calif., are also constructing a number of naval flying boats that will be similar to the one described. These will have the service classification as PK-1 and PD-1, respectively.

The PN-11 is a recent type of naval patrol plane that has many commendable features, although none are under quantity production for service use. The Naval Aircraft Factory developed this flying boat. The good construction features of this craft are: a well-arranged navigator-bomber's compartment, wide passageways and ample overhead space, instruments well placed, good space between the side-by-side pilots, easy anchor handling and stowage, and fine directional control in taxiing.

Another interesting type of naval patrol plane that will be described in some detail is the XPY-1. This flying boat, with many excellent characteristics, was the result of a design competition open to the American aircraft industry and awarded to the Consolidated Aircraft Corporation of Buffalo. A small number of these are now under construction and will be known as P3M-1's. They will embody some modifications recommended by the trial test board at the Naval Air Station, Anacostia.

Type. Naval patrol monoplane flying boat: class designation XPY-1.

Wings. Externally braced monoplane, high above the hull, of Gottingen wing section. Metal spars are built-up Warren trusses, with extruded aluminum alloy flanges and webs. The wing struts are tubular duralumin. Lateral stability (afloat) is obtained by two outboard floats, fourteen feet from the hull.

Hull. All-metal, single-step, with some of the lines of the old NC boats of transatlantic fame. The hull structure consists of two

keelson plate girders and central keel truss, outboard of which are longitudinals with close spacing. Duralumin sheet forms the bulkheads and the hull plating is of similar material.

Tail unit. Monoplane tail carried on a fin-shaped structure, built up from the hull. Two balanced rudders and two fins of duralumin framework, fabric covered. A single elevator is unbalanced.

Special features. Crew of five is carried. Navigator-bomber's cockpit is in the nose, with a flexible machine-gun mounting. Just aft is the pilot's cockpit, seating two side by side. Next is the radio, followed by the fuel compartment and mechanic's station. Flexible machine-gun stations are aft.

Dimensions. Span, 100 ft.; chord, 11 ft., 6 ins.; over-all length, 62 ft.; over-all height, 15 ft.

Weights and loading. Weight empty, 8,200 lbs.; useful load, 5,600 lbs.

Performance. Maximum speed, 118.5 m.p.h.; stalling speed, 58 m.p.h.; ceiling, 17,000 ft.

Power plant. Two 425-hp. Pratt and Whitney geared Wasps.

Desirable Basic Requirements

It is axiomatic that the appointments and characteristics of naval vessels are left, in the last analysis, to the decisions of those who may be called upon to operate these ships in battle. It seems logical, therefore, to apply the same principle to naval aircraft and their operators. Designers in their struggle for lightness and superior performance are inclined at times to disregard the opinions and recommendations of those who may be called upon to fly their products under conditions of war. One might imply from this statement that criticism of our aircraft designers is intended. The underlying thought is that an efficient naval patrol plane can only be constructed by a good balance of military, performance, and equipment features—this balance being achieved by close coöperation between the designer, manufacturer, and operator.

With this solely in view, a naval aviator submits what he believes are some desirable basic features. The general type under consideration is a naval patrol and bombing flying boat, the range of which with military load is approximately 1,200 miles and endurance at cruising speed about 15 hours.

Performance

The stalling speed should be as low as possible, preferably less than 50 m.p.h with a moderate load. The tendency of design is towards higher landing speeds. A high take-off or landing speed makes a seaplane valueless in a moderately rough sea. The service ceiling should not be less than 16,000 feet. Cruising speed and maximum speed should be as high as possible but secondary to a large useful load. The flying boat (two engines) should be able to stay in the air with fair controlability on one engine with a moderate load.

Engines

Air-cooled engines are preferable at present, due to reliability, durability, and effective thrust horsepower per pound of weight. Furthermore they are less vulnerable and require less upkeep than water-cooled engines. With the present engine position, the manufacturer should provide a light metal, detachable platform for the mechanic. Otherwise serious loss of time and material is the result while operating afloat. The engine mount should be simple, to facilitate changing engines, and the cowling should be readily accessible.

Fuel System

To economize space in the hull, i.e., to permit wider passageways, a smaller number of large main fuel tanks with the same total capacity could be built. Additional space could be saved by having the tanks conform more to the shape of the hull. The tanks should be removable at major overhaul through detachable upper shell plating.

Each gravity tank should have separate shut-off valves operable by the mechanic in the hull and each should be piped to supply both engines (two-engine boat). All gasoline shut-off valves should be accessible to the mechanic in flight.

The hand pump should have a larger capacity than the fuel consumption of both engines.

A jettisoning valve should be installed.

Hull Construction

First and foremost, the hull should be sturdy and seaworthy. The nose construction should be strong to withstand abuse

from impact with small boats, tenders, and docks. The bow cleats should be firmly secured to assist in breaking ground when anchored and also in snubbing the buoy line when mooring. The step construction should be simple to facilitate repairs. The tail unit should be high out of the water and built to withstand hydrodynamic as well as aërodynamic forces. Simplicity and accessibility of the interior construction must be considered to aid in combating corrosion. Serious consideration should be given to providing clear passages, head room, and a watertight hull above water.

The ideal arrangement from forward to aft is as follows: navigator-bomber's compartment, pilot's side-by-side cockpit, radio compartment, main fuel compartment, and gunner-mechanic's station. Past and present design does not give enough space to the forward compartment. It is especially desirable that a clear passage be provided between the radio and navigator's compartments.

Communication

In addition to an efficient long-range main radio set, it is essential that an auxiliary, independent, power-driven set be provided with a sending range of about 100 miles. This set is vital for communication when the flying boat is on the water and the main engines not running. Interior communication would be vastly improved if the ideal hull layout were followed in conjunction with other suggestions in succeeding paragraphs. Radio shielding of the engine is important. The possibility of radiotelephone installation should be investigated.

Maneuverability (Water)

It is imperative that a flying boat have good taxiing characteristics. It should handle with facility on the water while approaching docks, runways, tenders, and buoys without the aid of a small boat and while light breezes prevail. This necessary feature is not inherent in some of the more recent designed patrol planes. Incidentally, a good idling engine contributes in no small measure to this characteristic.

Military Features

It seems desirable, as the service ceiling of bombing patrol planes is increased, to construct an after tunnel gun in order to eliminate the blind tail area. The bomb release mechanism should be electric and positive in action. The shell plating in the area of the main fuel tanks might be of bullet-proof metal. This structure of dissimilar metals in the complete shell plating will present, however, a problem in itself, but the idea seems worth investigating.

An engine muffler, providing one can be developed without appreciable loss of power or increase of fire hazard, would be of some military value. The reduction in noise would minimize one of the causes of the crew's fatigue and would make possible interior telephonic or voice-tube communication. Noise will be greatly reduced too as a consequence of slower propeller speeds, made possible by reduction gearing.

Habitability

Habitability and general comfort of the crew have evidently been given scant consideration in the past. More important problems undoubtedly demanded the attention of flying boat designers. Since efficient performance of flight duty is intimately linked with the physical condition of the crew, it seems important that this subject be given serious thought.

To quote Dr. Maurice Dornier: "One of the three principal factors responsible for all airplane accidents is overburdened and unprotected pilots." In a lecture before the Naval War College in 1923, Captain Gherardi, U. S. Navy, stated: "In the course of a night scouting flight, ten or more hours in duration, varying conditions will be encountered and if aircraft are to reach a level of military dependency, the physical failures of the human being must be reckoned with and given serious consideration."

The British Royal Air Force designers have turned into practical effect what they call the greatest lesson learned from Colonel Charles A. Lindbergh's flight across the Atlantic. The result is a new fighting plane in which the pilot sits in an entirely enclosed cockpit.

Fatigue is caused largely by exposure to wind and weather and by insufficiently silenced engines (assuming the flying boat has good inherent stability). Another contributing factor may be a badly designed instrument board, the dials of which are poorly arranged or obscured by the wheel control. The lighting system is often faulty.

There seems to be no good reason why the pilot's cockpit of a flying boat should not be entirely enclosed in a cabin of non-shatterable glass which should be so treated as to prevent it from becoming frosted at high altitudes. The windows should be capable of being quickly raised or lowered and an efficient windshield wiper should be provided. Adequate ventilation should also be installed. This cabin should not be an afterthought but incorporated in the original design of the aircraft.

Devices to control the flight path or course of flight would not only relieve the pilot but also maintain greater accuracy than is possible by human effort.

The bombing flying boat of the future that will reach a service ceiling of 16,000 feet should, under many conditions of war, maintain that altitude for hours. The temperature at that altitude for average annual conditions in 40 degrees north latitude ranges between 22° above and 5° below zero (Fahrenheit). The average temperature of the hot summer day at the surface changes to about 10° below the freezing temperature at 16,000 feet. It seems logical, therefore, that the different compartments should be exhaust heated. Especially does this apply to the bomber's compartment. Otherwise a bomber, numb with cold, whose hands are protected with cumbersome gloves, will not get results. Effective bombing is the direct result of perfect teamwork between the bomber and pilot and so each should be well protected from the elements. The mechanic's comfort, too, should be considered. His efficiency will unquestionably be improved.

It is a matter of record in the World War that the effect of bombing above 16,000 feet was reduced to the vanishing point. This was due, in the main, to human limitations. It is a matter of common occurrence nowadays to reach almost twice that altitude in flight tests with an artificial supply of oxygen and electrically heated clothing. However, the conditions of an altitude test are quite different from the prolonged endurance required of a high altitude bomber and his pilot.

Equipment

Experiments with patent anchors should be continued, due to their excellent housing characteristics, until one is evolved that has good holding qualities on any bottom.

It is believed that a high altitude bombing flying boat should be equipped with an improved and less cumbersome type of parachute for war-time operations. The seat part of the parachute should, if practicable, also be a life preserver. This gear would probably not be practical for the bomber to wear continuously. It could be stowed close at hand, however.

Trend in Design

Concentration in the past in flying-boat construction has been primarily focused on the biplane form. This is due to the compactness and strength inherent in this type —very necessary characteristics. The future will undoubtedly see more construction of the monoplane, cantilever type whose aërodynamic and structural cleanness manifests itself in superior performance.

The design of both the biplane and monoplane will be refined to eliminate the details that create turbulence in the flow of air without creating a proportionate amount of lift. This will be partly achieved by more efficient power-plant position (in the leading edge of the wing), an improved engine cowling, and fairing nacelle with wing.

The trend should be to decrease stalling speed. The most important trend should be the construction of multi-engine flying boats that are controllable with one power unit out of operation. The immediate future will probably see no radical change in the actual power plants of flying boats. Better propulsive efficiency, however, is anticipated. There will probably be a trend towards the perfection of an air-cooled V-engine or liquid-cooled engine for the high effective thrust horsepower units necessary in large flying boats.

Most of the suggestions involve more weight—the deadly enemy of performance. The added expense of construction details, too, will be no small item. However, why not translate the improved aërodynamic efficiency of the immediate future in the direction of a better balanced product rather than a little greater speed or a little greater ceiling or a few more miles in range? The compromises in the future should be decidedly more on the side of the operating personnel. Then and only then will the naval bombing and patrol flying boat contribute most "to aid the surface units in gaining and maintaining command of the seas."

The General Board *of the* Navy

By JARVIS BUTLER

THAT able body of naval statesmen" referred to by former Secretary of the Navy Josephus Daniels early in his administration not only identifies the General Board of the Navy but offers the most succinct definition of an organization born of necessity and proved through years of continuous service of the highest character.

So much misconception exists in the lay mind, and in some quarters where a better appreciation should prevail, that it is not surprising that the General Board should be the object of a wide range of estimated worth. Hence it is one day accused of doddering conservatism, the next of autocratic leadership fostering imperialistic militarism. It has been confused with the General Staff of the Army and some have charged it with the expenditure of all naval appropriations while others with equal or less knowledge of the history of its service have denoted it as "that gold-laced tribunal of political admirals."

One may well ask: What are the facts surrounding this Board? What are the professional qualifications of its members? How does it function and how does it arrive at its conclusions, and what is its authority? To answer these questions is not a matter of difficulty for the General Board is not a mysterious agency of devious complexion nor is it obscure in its comings and goings.

Abnormalities are generally either useless or dangerous. Freaks are either laughed at, pitied, or feared. Normalcy is the criterion of progress and success. This is true in nature, it is also true in all fields of human endeavor. If you see a piece of machinery running along without a governor or not under perfect control, you know that disaster is imminent. If you know of any great organization without a controlling and coördinating agency, you know of an organization on the road to bankruptcy or ruin.

There is no intrinsic merit or supernatural character in governmental organizations which lifts them above the common fate of commercial bodies operating under inadequate control and guidance. If inefficiency or disaster rule or overtake a governmental agency, the results affect the whole nation and not a restricted community or a single industry. Hence it is that all governmental organizations, especially those charged with the problems of national defense, must be guided by sound judgment and administered by master hands.

With the foregoing in mind it naturally follows that the United States Navy, the first line of defense of our country, must utilize the most acute sagacity, the broadest experience, the keenest ability at its command in formulating its policies, in developing its material, and in operating its units. It must have a balance wheel and a supersensitive controlling agency; hence the General Board. The General Board of the Navy is the balance wheel and coördinating body which advises the Secretary of the Navy in maintaining a sound and progressive program for the development and strategic functioning of the United States Navy.

This is a mechanical age and the Navy is overwhelmingly mechanical. This makes for restless energy and enthusiasm among its personnel, always on the lookout for new avenues of development and loftier heights of achievement. The General Board is the agency which guides and directs this energy and enthusiasm into channels which preserve a continuing, rational advance in equipment and its employment, which guarantees the people of the country the maximum usefulness of the Navy with a minimum of lost motion and misdirected effort.

A fundamental difference exists between the bureaus of the Navy and the General Board, in that each bureau views its work with reference to its specialty as a part of

the Navy Department with subordination to the national policies as a background, whereas the General Board views the questions before it taking the Navy as a whole to be harmonized with other efforts of the government in behalf of the nation, with a background of the world controlled by interests other than those of the United States and sometimes hostile thereto. Herein lies the vital value of the Board to the Navy and the nation.

A great American naval thinker, Rear Admiral William L. Rodgers, at one time executive head of the General Board, has said: "In the Navy, as in any other organized institution, civil or military, there are two sides. It must exist and it must work."

For more than a hundred years the Navy had no provision in its organization which recognized the axiomatic principle given by Admiral Rodgers. The Navy Department had been a branch of the War Department from 1794 until erected into an independent department by Congress in 1798; yet its organization was so elementary that it was scarcely a navy in the true sense of the word until the organizing Act of 1815 following the close of the War of 1812. While this act provided an administrative organization for the Navy's existence, it practically ignored the operation branch which would give it a continuing objective policy, and adverse executive decision voided the few provisions that were made to that end.

This condition of affairs continued down to the time that war with Spain seemed unavoidable. At that time, in the spring of 1898, Hon. John D. Long, Secretary of the Navy, found himself without professional knowledge of naval warfare and with no agency in the Navy Department to give him the needed advice. War was about to be declared before Secretary Long had solved his problem by bringing together the so-called "Naval War Board of 1898."

This Board, the forerunner of the present General Board, was at best a makeshift. In the face of extraordinary handicaps, however, it functioned with distinguished success. We are indebted to Admiral A. T. Mahan, the greatest naval authority of modern times, who was a member of the Board, for a knowledge of its work, the reasons for its creation, the scope and nature of its duties, and their relation to the administration of the Navy Department.

In a document, here printed in part for the first time, prepared in 1906 by Admiral Mahan and sent to Admiral of the Navy George Dewey, President of the General Board, Mahan wrote:

> In its first form, as stated by the Secretary of that time, Hon. J. D. Long (*The New American Navy*, Vol. I, p. 162), the Board consisted of Assistant Secretary Theodore Roosevelt, Captains A. S. Crowninshield and A. S. Barker, and Commander Richardson Clover, who "were asked to act in that capacity just before the war began." It appears from recent letters to me of Admirals Barker and Crowninshield that other officers also were at times present, officially yet informally, and afterwards dropped out, with equal informality. The words underlined imply an informal commencement; which corresponds to the recollection of Captain (now Rear Admiral) Barker, that, until the late Rear Admiral Sicard replaced Assistant Secretary Roosevelt, no definite orders were given to those who thus met as a Board.
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> Rear Admiral Sicard's own orders, April 16, 1898, were simply to report for such duty as might be assigned to him in the Secretary's office; the nature of his duties were not specified, nor has any order specifying them been found. Captain Barker being then attached to the office of the Secretary, Captain Crowninshield being Chief of the Bureau of Navigation, and Commander Clover of the Office of Naval Intelligence, points also to the conclusion that, as originally constituted, the Board was simply a meeting of officers whose other particular duties indicated them to be proper persons for fruitful consultation, and for coördination of the many and speedy steps which had to be taken, outside and above bureau action, in the pressing preparation for war. As such steps would need the Secretary's sanction, in whatever way given, the Board fell naturally into the position of an advisory body; to which function, as far as my observation went, it was limited throughout its existence.
>
> This function of advice constituted the *relation* of the Board to the administration of the Navy Department throughout my acquaintance with it; and from my communications with President Roosevelt, ex-Secretary Long, and Rear Admirals Barker and Crowninshield, I gather that, although perhaps never formally stated in orders, such was its office from the beginning. It possessed neither original nor executive powers. To this correspond the following words of Mr. Long, taken from the passage before cited: "The Secretary lacking professional experience, and the Navy being without a General Staff, it was necessary that he should have the assistance of such a Board." The underlining is mine; and the well understood limits upon the authority of a General Staff designate exactly that exercised by the body to which it is here likened, in its relations to the head of the Navy Department.
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> The Secretary's lack of professional experience, together with the non-existence of a General Staff to supply that lack, mentioned in the words just quoted, contain the *reasons* for the organization of the Board, as apprehended by the person who

had the most direct knowledge of such reasons. Further on, he states explicitly the *scope* and *nature* of the duties intrusted to the Board; thereby defining, implicitly, the particular kind of professional experience in which the Secretary considered himself lacking, to supply which the Board was created. "The Board was eminently fitted to coördinate the work of the Department and the Fleet, and to keep a general surveillance over the larger strategical and technical questions, which could not be dealt with by the commanders in chief of the several squadrons."

Respecting possible interference by such a body as the Board with commanders at sea, Admiral Mahan points to the Department's directions to Admiral Sampson, commander in chief, on May 12, 1898, to concentrate his squadrons when it was learned that the Spanish Admiral, Cervera, was off Martinique en route to a Cuban port. Admiral Sampson and two of his subordinate commanders made independent decisions, but all toward the same end, the capture or destruction of Cervera's ships. Admiral Mahan writes:

> The instance is interesting, as showing three different decisions, and also as illustrating that the existence and the advice of the Board did not necessarily cramp the initiative of local commanders—the most dangerous tendency of such a body.

As a help in understanding the importance and character of the work of the present General Board, part of the experience of the War Board of 1898, as set down by Admiral Mahan, is invaluable. He observes that:

> During Sampson's return to Key West (from Cuban waters) with his division, there were periods long enough to be of importance at such an instant, in which he was out of touch with the situation; whereas the Department, stationary at Washington, could and did receive continual information, and could take necessary steps. Such a condition not only may, but almost certainly will, recur hereafter; for telegrams (this was before the days of radio) can always outrun vessels, and in a passage of a week most serious action may need to be taken, for reasons which the admiral cannot know soon enough. The need of a central authority is evident; that authority is the government; if it lacks "professional experience," it must have a professional adviser. Time and opportunity cannot be lost in deference to the prerogative of a commander in chief. Respect for the latter will be observed, if there be common sense and tact in the conduct of the central authority; and it may be remarked that the professional sympathy of a competent professional adviser will intuitively avoid needless occasions of friction, which a civilian (such as the Secretary) may not foresee.
>
> The present extension of telegraphic (and radio) systems has modified very seriously the relations of central governments with their functionaries all over the world, as well diplomatic as naval. As regards the latter, however, the change rests chiefly upon the superior facility for receiving and utilizing information possessed by a stationary authority over one that is moving. . . . There is a class of mind easily fascinated by the idea of action taken independent of orders, or even contrary to them. That such action is sometimes most commendable is true; but the responsibility taken must be clearly enforced in the general orders issued to each unit, that the commander may understand clearly that he will be held to strict account to justify difficulty in finding him, in consequence of such action. The getting and distributing of information is of such prime importance that eccentric movement in a unit is much more likely to do harm than good.

With the close of the Spanish-American War, the War Board of 1898 quietly went out of existence, yet its work was of such vital importance that its loss left a gap in the machinery of the Navy Department. It is not surprising then, that Rear Admiral H. C. Taylor, Chief of the Bureau of Navigation, in 1900, Hon. J. D. Long still being Secretary of the Navy, was able to secure an order for the establishment of the General Board of the Navy. This was Navy Department General Order No. 544, dated March 13, 1900. Thus, coincident with the beginning of the twentieth century, an era which has been marked by extraordinary maritime developments, with industrial and mechanical advancement of epoch-making import, and by the greatest war of all time, the General Board began its fruitful mission in the development of the United States Navy into one of the world's greatest fighting forces.

The duties of the General Board, as laid down in the general order establishing it, were defined as follows:

> The purpose of the Department in establishing this Board is to insure efficient preparation of the fleet in case of war and for the naval defense of the coast.

A great factor in the immediate acceptance of the Board on the part of the rank and file of the Navy, and its prestige with the public at large was the presidency of George Dewey, Admiral of the Navy. His place in naval history was already won, his character was above reproach, his professional attainments were of the highest. Thus the development of the Board to its present high position in our naval establishment was assured from the first. Admiral Dewey retained the presidency until the day of his death, January 16, 1917. He met with the Board on matters relating to our en-

trance into the World War just a week before he passed away, and in tribute to his memory there has never been a president appointed to that office since, the senior member officiating as such.

It will be noted that the same conditions obtain in the General Board that marked the Naval War Board of 1898, in that it exists without authority of Congressional law, although acts of Congress have recognized it. It may be abolished at any moment by order of the Secretary of the Navy, by whose order it was created. It is without administrative duties; it is purely advisory. Its value to the service and to the country rests on two points: First, the officers ordered to membership are of high professional attainments, of sound judgment ripened by experience, commanding the respect both of the Navy and of the Secretary who appoints them. The majority of its members the past thirty years have fulfilled this first condition. The other condition to which the Board owes its continuing weight is that it has an excellent system of records and has followed an enduring policy.

Even the novice can understand the great and fundamental differences between the General Board and the General Staff of the Army. While the Board is a departmental creation, without executive or administrative authority, the General Staff is the creation of organic law, giving it both executive and administrative powers, although it exercises no command. Under the law its officers are charged with preparing plans for national defense, and in addition they "render professional aid and assistance to the Secretary of War and the Chief of Staff."

Among the duties of the General Staff is a supervision for the Secretary of War of his *military* responsibility. Officers of the General Staff act as agents of the Secretary of War "in forming and coördinating the action . . . . . of all troops of the line and of the Adjutant General's, Inspector General's, et cetera . . . . Departments." They are expected to obtain, to anticipate, and to initiate any necessary action in the field particularly assigned to them. Their initiative is not restricted. While the work of the General Staff has to be approved by the Secretary of War to become effective, yet the Deputy Chief of Staff, and the heads of the five General Staff divisions, within the limit of their own particular responsibility, are each empowered to issue orders through the Adjutant General in the name of the Secretary of War. Understanding these matters there should be no further occasion for confusing the General Board of the Navy with the General Staff of the Army, nor should there be any misunderstanding of their respective duties or authority.

In 1915, Congressional action created the Office of Naval Operations. This affected the General Board's functions in that the new organization assumed the responsibility for executive plans for mobilization and for war, and the General Board was left purely as a consultative body for the consideration of matters of general policy of the Department where careful study was needed. In consequence, the position of the General Board at present is that defined in *Naval Regulations,* namely:

> The General Board shall be furnished, for information, with the approved War Plans, including coöperation with the Army and employment of the elements of naval defense.
>
> It shall consider the number and types of ships proper to constitute the fleet and shall advise the Secretary of the Navy respecting the same, including such increase as may be requisite, to be submitted annually to Congress.
>
> It shall consider and report upon such subjects as the Secretary of the Navy may lay before it.
>
> When designs are to be prepared for a new ship, the General Board shall submit to the Secretary of the Navy a recommendation as to the military characteristics to be embodied therein. Such military characteristics shall include a general statement as to the type of ship, speed, radius of action, and armor and armament, but shall not, except in special cases, be so restrictive as to prevent arrangements being developed in order to obtain the benefit arising from the consideration of several solutions. These military characteristics shall be prepared by the General Board sufficiently early to permit the preliminary design . . . . to be prepared and the approximate cost determined before the estimates for the yearly building program are submitted.

In compliance with these regulations, one of the principal duties of the General Board is to *initiate* the building program of the Navy; otherwise it has very seldom taken the initiative in thrusting its views on the Secretary of the Navy, and never on a bureau of the Navy. Its critics who have accused it of arbitrary powers and autocratic tendencies are not sufficiently cognizant of its status and character to judge it, and their accusations are gratuitous and as unjust as they are false. And only in its advisory capacity in the matter of ship design for the annual building program has the General

Board even an indirect hand in spending naval appropriations.

In the Board's problems of shipbuilding and, in fact, naval policy, the treaties of the Washington conference of 1921-22 have made a profound change. From being a treaty-free Navy, our Navy is now treaty-bound. The difference is very great and of tremendous importance. We can no longer build ships of a design which seems to us to be desirable, but only such ships as are desirable within the terms of the treaties. Thus the treaties are the actual and invariable basis for all the design work of the bureaus and the General Board.

It should be remembered that the General Board was not responsible for the treaties evolved at the Washington conference. In every instance its advice and recommendations to the Secretary of the Navy during their preparation fully safeguarded the interests of the nation from the naval standpoint. Apparently all of its recommendations were not embodied in the treaties, and perhaps it was not in full accord with the provisions of the treaties as made. Those treaties were essentially diplomatic, controlled by diplomats, and are the children of diplomats, not of the General Board. Nevertheless, the General Board and the Navy Department accepted the administration policy at the conference as a governmental policy to be considered in the spirit of Stephen Decatur, who gave to the service the toast: "My country, right or wrong!"

Observing the limitations placed upon ship design by the Washington treaties, the General Board, in deciding on a shipbuilding program to recommend, makes a survey of world politics and resources and the relation and interests of the United States thereto. This is to determine what will satisfy the requirements of national defense, whether it is possible to get along with fewer ships than the authorized policy permits, or must we go as far as the policy allows without the risk of starting a new race in naval armaments? This involves a careful study of the policies of the great powers, the probability of the League of Nations really functioning, and the trend of world thought and action respecting force. It is still the availability of force and the willingness to use it that makes the word of law prevail. If this country desires to maintain the prestige of its ideals of political thought, to defend itself and help oppressed peoples in addition, the instrument to use, owing to our geographic position, is a strong navy.

This means that our Navy must be able to search even the most remote waters of the globe, to protect our own commerce, and to destroy the enemy's military and economic commerce. In these considerations the General Board must observe the fact that we are treaty-bound; we have no fortified positions, nor can we have them, west of Hawaii. Hence great cruising radius is an imperative characteristic in ship design for our Navy. Here the General Board takes the initiative in relation to the technical bureaus, and the design of our ship becomes the result of compromise. The Bureau of Ordnance wants this and that for guns and ammunition; the Bureau of Engineering has its demands for propulsion and other power equipment; the Bureau of Construction and Repair has its ideas of the hull and its dimensions. Over all are the limitations of the treaty. All these conflicting and limiting factors and demands must be whipped into a workable scheme by the General Board.

Before the treaty-bound program was imposed the various bureaus could more readily get their plans adopted; a few tons added to a ship made very little difference, now it makes all the difference in the world.

Before coming to a decision, the General Board holds exhaustive hearings of representatives of the bureaus, the fleet, and others, military, naval, and civilian, who have special and technical knowledge of the questions under discussion. Nothing is done hastily, no snap judgment is tolerated. *Facts* determine the final action of the Board.

This procedure is followed in the consideration of all subjects of importance. In the case of the now famous report to the Secretary of the Navy on the relative value of aircraft and surface craft in war, the Board held protracted hearings. Eighty-three persons were interrogated. These were representatives of the Army, Navy, manufacturing establishments, the scientific world, and embraced men of all ranks—commanders, fliers, engineers, and ground personnel. Wild dreams and over-enthusiastic estimates were shorn of their glamor; facts alone were sought.

The statements of one witness, at least, were at variance with public utterances before and since. He did not advocate before

the General Board the abolishment of the Navy, nor of battleships, nor of any other type of naval craft. His claims for aviation were of a sensible character, in accord with the known characteristics of aircraft and within the possibilities of aërodynamic law. So great is the respect for the General Board and its honesty of purpose that, when before it, he abandoned tactics for which he was noted and gave a clear and concise recital of the probable rôle of military aëronautics, helpful to the Board and to the country.

The General Board has been accused of hampering the development of naval aviation, of fogyism, and downright indifference to that vital phase of naval armament. Its published recommendations are readily available to refute this charge and show its real conception and advocacy of aviation.

Shipbuilding programs, characteristics of vessels, and the relative value of air and surface craft, however, are not the only subjects considered by the members of the Board and their associates. They have established their position as naval statesmen by the broad vision exercised and sound conclusions reached which they have recommended to the Secretary of the Navy in widely varying fields related to the welfare of the nation. The action of statesmen is needed, and is found, in the consideration and recommendations upon such topics as:

Draft of convention on private manufacture of arms and ammunition and implements of war.

International Conference on Safety of Life at Sea.

Construction of transisthmian highway in Panama.

Draft of convention relative to responsibility of carriers by aircraft.

Exchange of flight privileges with foreign nations.

Inter-American commercial aviation convention.

Naval policy.

Studies made for the guidance of U. S. delegates to Conference for Further Limitation of Naval Armament.

In reaching its conclusion, the most intensive study is given every phase of the problem presented. Opinions based on real knowledge and experience are welcomed, and the final recommendations of the Board are thus based upon the most exact information obtainable in America, reënforced often by the experience of other lands gleaned by our diplomatic, commercial, military, and naval agents abroad.

In order to secure that measure of coöperation with other elements of the Navy which insures real progress and harmonious action, the General Board has, as ex-officio members, the Chief of Naval Operations, the Major General Commandant of the Marine Corps, the Director of Naval Intelligence, and the President of the Naval War College, and such regular members and additional officers as the Secretary of the Navy may designate.

Thus every member is an officer of extensive professional experience and high personal attainments. The opportunity to analyze and conduct investigations of questions under consideration by men of such qualifications entitles the opinions of this Board to the highest respect. Any recommendation made by this group of naval experts necessarily receives instant approval on the part of the Navy as a whole. It has been ever thus, for the General Board has always been conducted by the most competent and most famous of our naval officers of modern times. In addition to Admiral Dewey, such men as Admiral Sigsbee, commander of the ill-fated *Maine* when she was destroyed in Havana Harbor; Admiral Robley D. (Fighting Bob) Evans; Admiral Sperry, who took the fleet around the world in 1908; Admiral Fletcher, commander at Vera Cruz in 1914; Admiral Sims; Admiral Mayo, commander in chief during the World War; Admirals Eberle, Coontz, Badger, and many others whose deeds are household knowledge with the nation, have given their weight to the Board's decisions.

Altogether, the nation is to be congratulated on the farseeing policy which brought the General Board of the Navy into existence. It is to be further congratulated that political considerations have never interfered with the Board's membership nor its deliberations. It is to be hoped that nothing will ever make political expediency a factor in the selection of its members, or in the character of the Board's duties. As it stands, it is a shining example of what such a body should be.

The Avenger *of* Blood

A Reminiscence of a Scene on Board a Man-of-War

By USHER PARSONS, *M.D.*

THE incident recorded by Usher Parsons, surgeon, U. S. Navy, serving on board the U.S.S. *Guerrière* (2d), having the title *The Avenger of Blood,* occurred about September 16, 1818. The commanding officer, the renowned Captain Thomas Macdonough of Lake Erie fame, reported the arrival of the *Guerrière* at Cronstadt on that date. The ship touched at that port to disembark the Honorable George W. Campbell, American minister to Russia.

Dr. Parsons was born on August 18, 1788, in the town of Alfred, York County, Maine, and was the author of nearly sixty publications, most, but not all, of which were on subjects connected with the medical profession. Captain F. L. Pleadwell, (M.C.), U. S. Navy, who has given much attention to historical research, contributed an account of Dr. Parson's life to the *U. S. Naval Medical Journal,* Vol 17, No. 3. In this pamphlet Dr. Pleadwell said:

> Some other published writings less known . . . . attest his permanent interest in his naval reminiscences. . . . . In 1840 he published in the *Knickerbocker Magazine* a story, "The Avenger of Blood," founded on an incident which occurred on board the *Guerrière* in 1818. In 1850 he helped to agitate the question of the abolition of flogging in the Navy, and wrote a pungent article on the subject for a New York newspaper. In 1862 he contributed to the *New England Historical and Genealogical Register* brief sketches of officers who were in the battle of Lake Erie.
>
> ELLIOT SNOW
> *Rear Admiral (C.C.), U. S. Navy*

'Twas in a dark, tempestuous night, that the frigate *Guerrière* ploughed her way through the Gulf of Finland, rolling and plunging at the sport of every billow, as it dashed its spray over her deck. The incessant creaking and groaning of the ship's joints at every surge, were occasionally interrupted by the hoarse sound of the officer's trumpet, or the shrill pipe of the boatswain, and the tramp of men running with the halyards.

"Steward," said the caterer of the wardroom, as he entered it from deck, "invite down all the officers of the mess about the galley, and all others that can be spared from duty. Tell them it is Saturday night; and mind ye, have ready the large can of whiskey-punch, piping hot, and materials for replenishing it."

The social board was soon surrounded, each mess-mate steadying himself in his chair, as the ship rolled from side to side, by embracing a leg of the table between his knees. The customary toast for Saturday evenings, "To sweethearts and wives," was drunk with the usual sigh of fond recollection; and then followed the enlivening song and mirthful story.

"There is some fun," said the sailing-master, "in that pilot who joined us at Copenhagen. If we could but get the Russian down from deck, he would make sport enough for us, in his broken English."

"We'll have him then," replied the first lieutenant. "Steward, ask the pilot to join us; and, look ye, have less noise in that gunroom when you return." The wardroom servants, who occupied the adjoining apartment, had evidently followed us in circulating the Saturday evening glass.

Presently, the rough, weather-beaten pilot appeared at the table, and turning his mustaches right and left, to open a way for the glass, he soon made up in speed what he lacked in time; and readily overtook us in the convivial race; nor did he fail to confirm the sailing-master's opinion of his mirth-moving powers. Little did he dream of the transition his feelings were soon to undergo. But I anticipate.

It is very common on board war-vessels, on pleasant evenings, for officers to stand within listening distance of the men about the forecastle, to over-hear, as it were unobserved, the songs and jests of the jolly sons of Neptune. In like manner, the noise from the servants' room had drawn the purser from the table to listen to their sport. After a time, he returned, with an expression of countenance that betokened astonishment at something he had overheard.

"Gentlemen," said he, in a low tone, "one of our servants is a pirate!"

"Pirate!" exclaimed the company.

"Yes," answered the purser, "a Baratarian pirate, who was convicted, and subsequently pardoned by President Monroe; and he is now giving an account of his atrocities to the other servants."

"By Saint Nevski!" exclaimed the Russian pilot, "dat is no vay de Emperor treats de pirates. He vould send dem to Siberia, to be knouted and den hunged!"

"Let us," resumed the purser, "have the rascal out here, and make him describe some of his piracies."

To this proposition all agreed; and John Smith, for such was his name, real or fictitious, was called forth, to entertain us with a story from real life. All eyes were arrested by the expression of his countenance as he approached the table, and each one would have been slow to suspect him of piracy, so innocent were his looks.

The first lieutenant began his interrogatories in a calm and serious manner, and grave tone of voice, remarking that he wished to know some of the particulars of the piracies committed by him and others, for which he was tried and condemned. With a look of astonishment at our knowing anything of his career, John hesitated.

"Go on!" said the lieutenant, "go on! we know you have been pardoned, and therefore you have nothing to fear from us. Let us hear the whole story."

John began, as might be supposed, with a disclaimer of his own guilt, in the outset; alleging his ignorance of the designs of the band with whom he enlisted, until it was too late to extricate himself. He then recounted several of their piratical adventures, some of which were detected, and led to their capture and trial. By this time he had become easy and communicative, and desirous to gratify our excited curiosity and interest in his stories. "But there was one act," continued he, "'that never came to light, which was worse than all the rest."

"Let us have it, John, out with it!"

"Well," continued John, "it so happened we fell in with a Russian ship, bound to Mexico, and boarded her. The captain, who was a brave fellow, resisted our search for money. We thereupon knocked out his brains with a handspike, and (oh, it makes me shudder to think of it!) we then killed every man on board; and after plundering all we could carry away, we scuttled the ship, and set fire to her."

"Vot Russian ship vas dat?" interrupted the pilot, impatient to learn whether he had ever any knowledge of her.

"It was, Sir," replied John, "the ship *Orloff*, Captain Nicholas Potowsky."

"Mine Got!" exclaimed the pilot, with clenched hands, and a quivering lip, "it vas my brodder! Villain! Murderer!—it vas my brodder Nicholas! You shall be put in irons, and hunged, ven dis ship arrives at Cronstadt! I vill see de captain dis very night. O Nicholas! You vas not drowned den, ship and all, as ve always supposed!"

The pilot now rose from the table to seek the captain, but was unable to pass the sentinel stationed at the cabin door. Meantime, John Smith was hurried down into the coal-pit, in a dark corner of the vessel, and was there confined out of sight, during the pilot's stay on board, which however was short, as we soon landed at Cronstadt. It was reported that he applied to the authorities there to take John out of the ship, but was told that, the *Guerrière* being a national armed vessel, nothing of the kind could be done. John therefore escaped due punishment, till we arrived at the next port, which was in Sicily, where, expecting another trial for his life, he immediately deserted, and was never more heard of.

The striking incidents of this narrative, the reader will perceive, are the perpetration of a murder in the Gulf of Mexico, and its first disclosure in the Gulf of Finland, nearly on the opposite side of the globe; and then to the brother of the victim, by the murderer himself. The whole savors so much of fiction, that the writer thinks it well to state that he was a surgeon of the ship at the time, and knows the material facts to be as he has here related them.

Have Airships *a* Military Value?

By LIEUTENANT COMMANDER JOSEPH P. NORFLEET, *U. S. Navy*

AIRSHIPS of the rigid or Zeppelin type have been the subject of much conjecture by both naval officers and the general public as to whether they really offer any military features which warrant their development as potential weapons of war. The Bureau of Aëronautics in championing the development of this type of aircraft has come in for considerable criticism in the Navy itself for wasting time and money on what most people believe to be a worthless cause. This article is an attempt to analyze, briefly and impartially, the probable future military value of this type of aircraft, and is based on about ten years' experience with this and smaller types of airships.

Already much has been written in defense of airships, but generally from a partisan standpoint and based on their use in the late war and what various high authorities had to say about them. The tendency of the advocates and defenders has been to emphasize good points and slur over weak ones, as will always be true in the case of a controversial question. In taking up the case for or against the airship, we might as well eliminate in the beginning all performances of present-day and past airships and admit frankly that these ships possess no military characteristics which, in view of their cost, would warrant their survival. The Navy has a limited amount of money to spend on aviation and it must be spent wisely. Recent developments in heavier-than-air craft and prospects of future performance require great improvements in the rigid airship if it is to survive as a military weapon.

What does the future hold for this type of aircraft? The Navy is now building two ships, each double the size of the *Los Angeles*. These ships are hailed as airplane carriers in addition to their supposed value as scouts. They will have a total gas volume of more than 6,000,000 cubic feet, which means a gross lift of about 200 tons when inflated with helium gas. They will carry five or six small fighting planes and will have a cruising radius of 7,000 miles at fifty knots speed. This is a paper calculation and, while technically accurate, is not apt to be reached in practice, due to the numerous factors that enter into the practical operation of airships and which prevent calculated performances from being reached except on special flights under perfect conditions.

These ships are conventional in design except for greatly improved strength features and provisions for carrying planes. Undoubtedly they will be a great improvement both in safety and performance over any present-day ship, if we neglect the two ships now building in England and not yet tested. It is not believed, however, that these two ships will add any appreciable strength to the military efficiency of the Navy, and for the very simple reason that two ships are not enough. Experimentally, yes, but not practically. The great potential value of aircraft for scouting purposes is the release of surface craft from some of these duties.

The Navy would require at least twenty large airships in a major operation if they are to fulfill their proper function. Where are these ships to be obtained? There is but one answer to this question—from a civil reserve consisting of transoceanic passenger and express airships. The Navy will never have money enough to develop a proper airship service, but the money spent on airship development will not be wasted if by its efforts the Navy proves the practicability of these ships for passenger-carrying and maintains in its service the nucleus of a real airship service in time of war with a few bases strategically located.

For years airship designers and pilots have looked forward to a 10,000,000-cubic-foot airship. It is logical to expect this as

the next step in development. It is also logical to rate this sized ship as a standard both for military and civil purposes. An airship's useful load increases directly as the volume, wherein lies its great advantage over the plane as a weight or passenger carrier over great distances. It is admitted that the airship is cumbersome to handle on the ground and that it is fragile under these circumstances, but so will be the large multi-engined plane if it ever develops successfully.

Let us picture our standard ship. In the first place we will get away from the use of only helium gas and from the use of gasoline. The 10,000,000-cubic-foot ship will have most probably a gas-tight cover of dural metal with a seal of helium gas inside the shell around central gas bags of hydrogen which will permit a better and more economical performance than an all-helium ship, with almost the same safety. It will use heavy oil for its motors or perhaps a gas such as the Blau gas used by the *Graf Zeppelin*. It is not improbable that it may burn hydrogen as a fuel. Its engines will give it a speed of well over 100 miles per hour, and it will be able to do 10,000 miles and carry in addition about 100 tons of passengers and express. Its crew will be about the same as the present type of ship with the addition of servants for the passengers. The above figures are only approximate, but are not unduly optimistic. They are given merely as a rough estimate of what may be expected from the airship of the future in the way of strictly commercial performance.

Let us consider the military value of such a ship or of a squadron of these ships which might be available to the Navy in time of war. Their size, carrying capacity, speed, and cruising radius suggest many auxiliary uses to which they might be put. As scouts their use may be limited somewhat to areas not in control of enemy air forces, but all other scouts except submarines will be very vulnerable to air attack in the next war whenever in the vicinity of an area of enemy air concentration. It is also quite possible for an airship to make observations from above the visibility ceiling, by lowering an observer in a towing egg connected by telephone with the control car. This was the German system for directing bombing raids from clouds or high altitudes. It is also quite possible to refuel at sea from surface aircraft carriers or other ships and so continue at sea indefinitely. A sufficient number of these ships could therefore render a most efficient scouting service either accompanying a fleet or from shore stations.

For convoying or guarding convoy routes, they can render invaluable service so far as the early detection of raiding surface ships is concerned. This is a service which they and the smaller nonrigid airships actually did render in the World War. Airships are superior in this respect to planes due to their ability to fly at any desired speed and conform their movements and speed to that of the convoy.

There are many difficulties to be overcome before an actual aircraft carrier can be developed from an airship. To carry five or six fighting planes for protection and as supplementary scouts is a simple problem. It is merely a question of how much weight can be released with safety without any means of compensating for it other than loss of gas. The tendency of nontechnical airship advocates to speak glibly of carrying and releasing dozens of planes is to be deplored, as most of these statements are made by people who should know better.

A fighting plane weighs about 3,000 pounds. To release ten such planes means an immediate change in lift of 30,000 pounds or fifteen tons. This is a rather large fish for even a 10,000,000-cubic-foot ship to disgorge at once, and to be effective as an airplane carrier more than this number of planes should be carried. It is quite feasible to carry enough planes for protection and supplementary scouting, and perhaps this is all we should look for in the airship of the near future.

The difficulties in handling airships have been rather magnified in the past due to unavoidable causes, not the least of which has been the absolute necessity of conserving the few ships that have been in existence. Money has also been lacking for the rather costly experiments necessary to develop safe mechanical means of handling. Much progress has been made in the past year or so at Lakehurst in this respect as money has become available to develop handling cars and the like which have long been desired. The Germans in their many years of airship building and experimentation did not stress mechanical methods, as

man power was always available to them in the shape of soldier garrisons. It remained for the English to invent the mooring mast, which has now been improved. In the future it is quite probable that the large ships will be handled and kept up by a much smaller force than is now required for the small ships of today. The mobile mast on a ship was the result of the projected flight of the *Shenandoah* to the north pole, though it was first suggested by the writer in the winter of 1921 as a possible use for some of the ships which were selected for retirement by the Conference on the Limitation of Armaments.

The mooring mast, whether of temporary or permanent character, will be of great assistance to airship operations, especially for military uses, but masts cannot take the place of sheds, and any commercial proposition must take into consideration the expense of terminals, repair sheds, and that which corresponds roughly to docking facilities for surface ships, at least at the main terminals of the lines.

These terminals on United States soil, whether publicly or privately owned, would of course be available to the Navy in war time if the ships were taken over and, when supplemented by temporary masts in strategic locations, would provide an airship organization capable of quick mobilization and military use. It would seem, therefore, that we should, through the agency of the Navy Department and Congress, encourage the development of transoceanic airship lines under American registry and with American capital. The crews of these ships should be part of our naval reserves and every encouragement should be given to capital in the way of mail contracts, terminals, and the like, that the civil government is able to give.

The answer, therefore, seems to be that the military value of airships, while easily demonstrable, will depend in our case on the development of a civil airship service strong enough to compete with that of other nations and to develop a national personnel for their operation. The conversion of these passenger ships for military purposes need not be a complicated or lengthy operation, as the airship will never be primarily an offensive war machine.

International News Photos, Inc.

TESTING THE NAVY'S NEW PORTABLE MOORING MAST

The U.S.S. *Los Angeles* hooked to the new portable mooring mast at Lakehurst, leaves the hangar as the mast is drawn out upon the field by a tractor preparatory to testing the new facilities which the new apparatus offers for landing, as well as launching. The portable mast passed the test satisfactorily, and is said to mark a real development in hangar equipment, since it greatly decreases the number of men required to assist in the take-off.

Courtesy Goodyear-Zeppelin Corporation

MASTER RING OF THE *ZRS-4*, TO WHICH THE NAVY DEPARTMENT RECENTLY ASSIGNED THE NAME *AKRON*
This ring is shown after being raised in place. The raising was celebrated by elaborate ceremonies.

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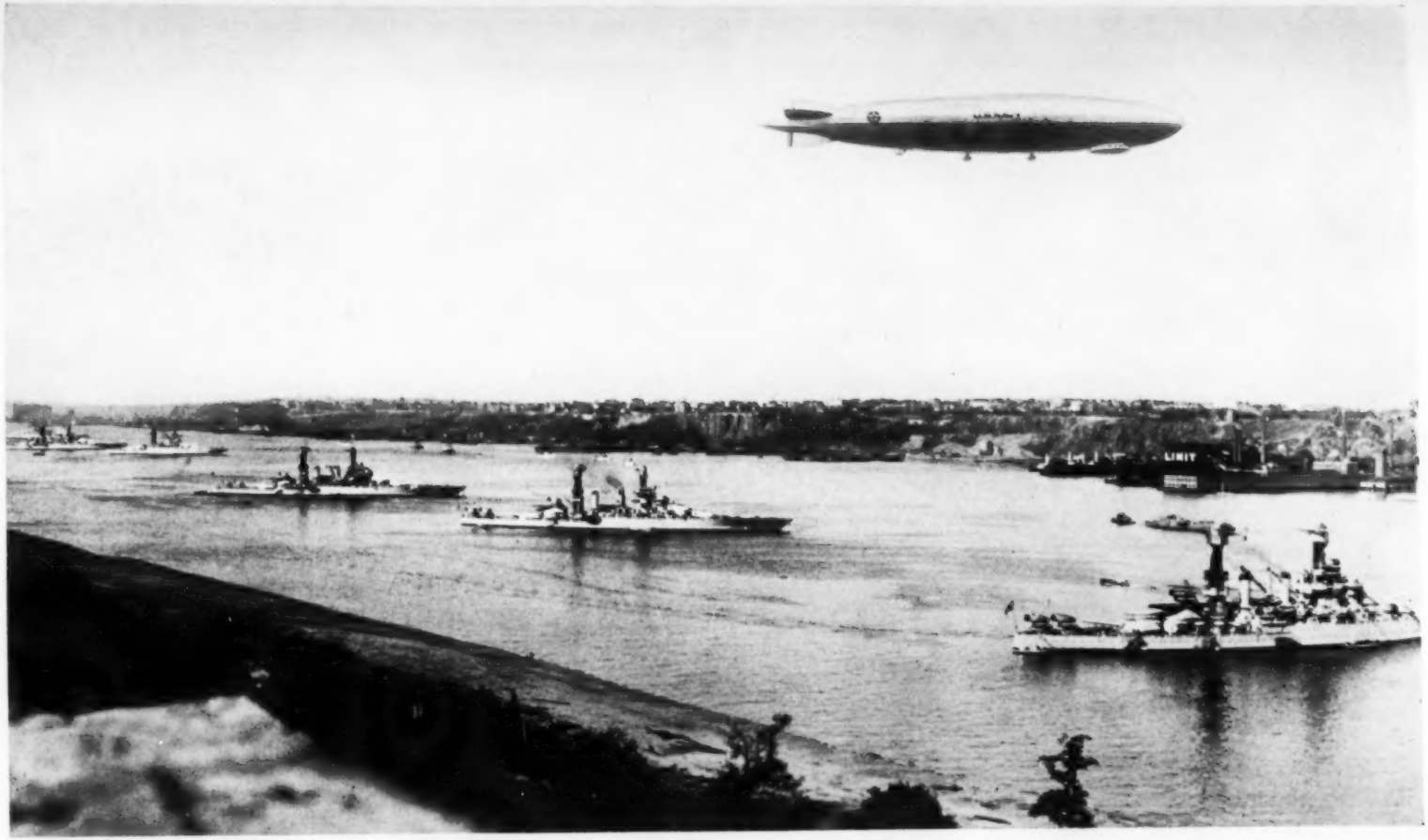
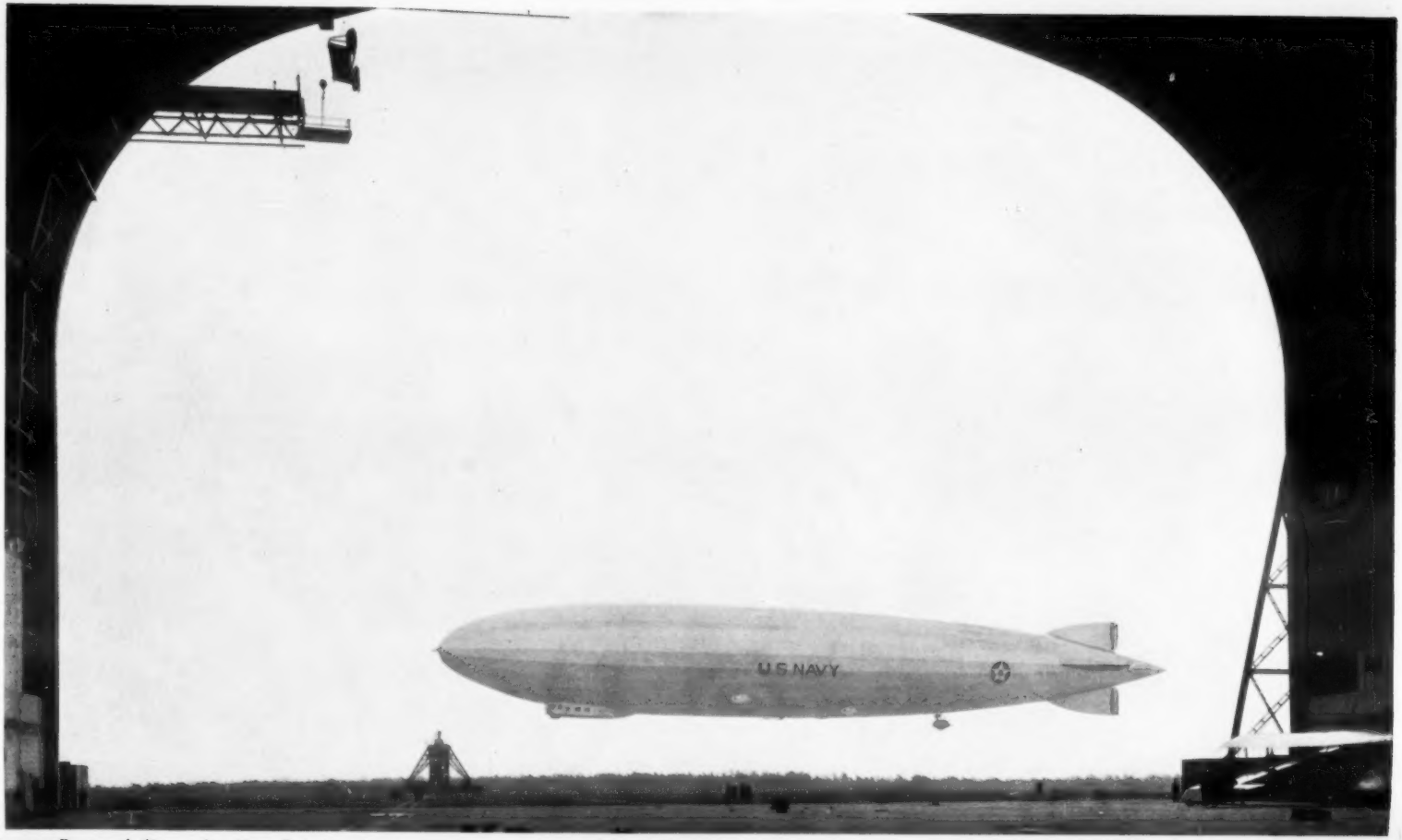


International News Photos, Inc.

A REMARKABLE PHOTOGRAPH SHOWING THE *LOS ANGELES* SOARING OVER THE VESSELS OF THE U. S. BATTLE FLEET AT ANCHOR IN THE HUDSON RIVER

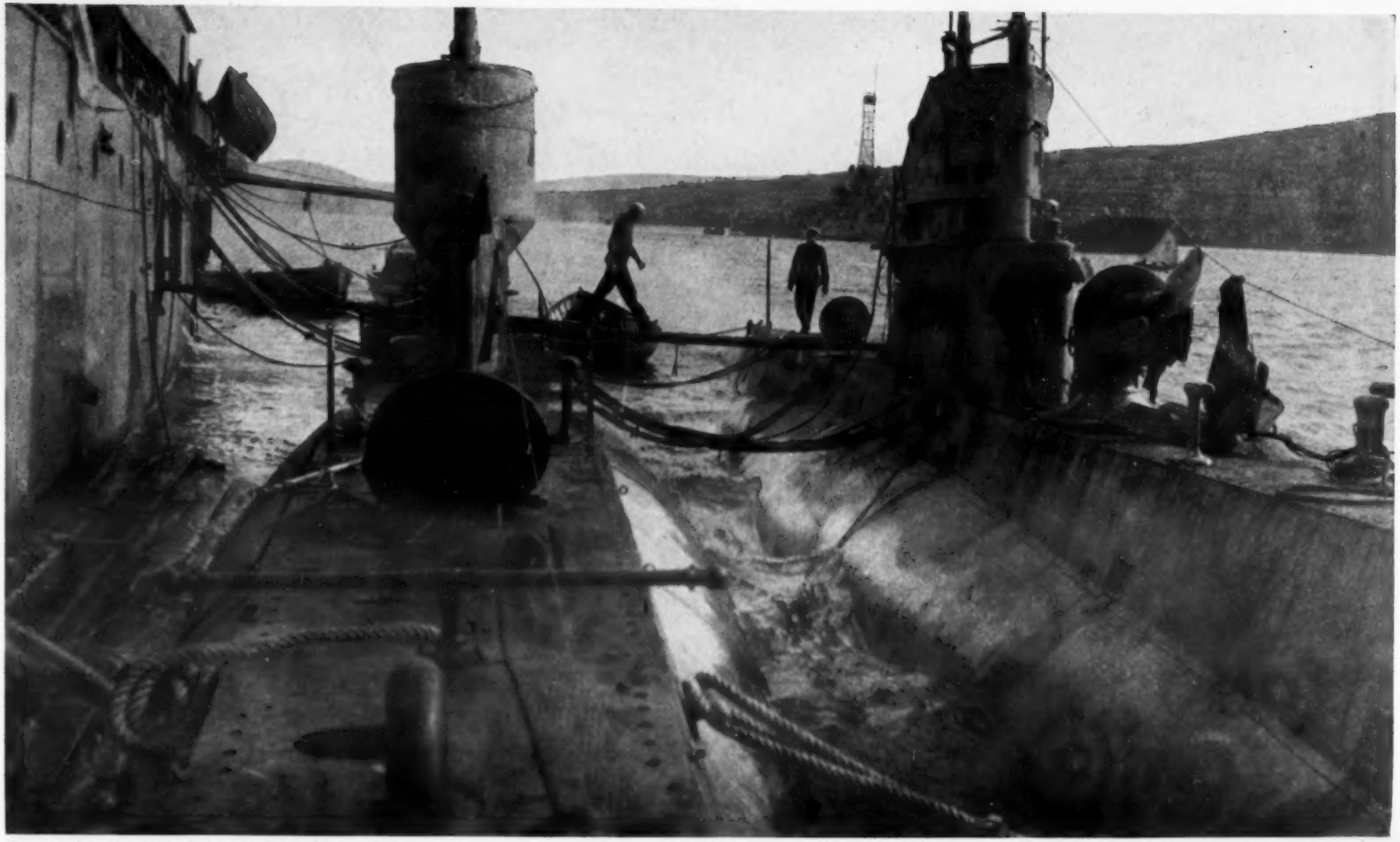


Courtesy Bureau of Aëronautics, Navy Department

U.S.S. *LOS ANGELES* LEAVING PORTABLE MAST

Courtesy Lieutenant H. F. Cope, U. S. Navy

U. S. SUBMARINE *AL-1* WITH THE U.S.S. *NEVADA* IN THE DISTANCE, AT BEREHAVEN, IRELAND



Courtesy Lieutenant H. F. Cope, U. S. Navy

U. S. SUBMARINES *AL-1* AND *AL-3* ALONGSIDE THE U.S.S. *BUSHNELL*, AT BEREHAVEN, IRELAND

U. S. SUBMARINES *AL-1* AND *AL-3* ALONGSIDE THE U.S.S. *BUSHNELL*, AT BEREHAVEN, IRELAND

Courtesy Lieutenant H. F. Cope, U. S. Navy

U.S.S. *K-6* AT HORTA, FAYAL, AZORES

UNIV. OF MICH.

CREW ON THE U. S. SUBMARINE *AL-11*

Courtesy Lieutenant H. F. Cope, U. S. Navy

U. S. Submarines *in the* War Zone

By LIEUTENANT HARLEY F. COPE, *U. S. Navy*

THE sixth of April, 1917, found the United States quite unprepared to carry on a submarine warfare in the enemy's waters, largely because the boats in commission at the time were not capable of taking the long trip across the Atlantic under their own power and of still being in condition to carry on war operations. The United States recognized no obstacles as insurmountable and great efforts were made to send a number of submarines overseas as quickly as possible. The first submarines scheduled to make the attempt was a division of K-boats, the *K-1* to *K-8* inclusive.

At that time the Diesel engine was very much in its infancy so far as our submarines were concerned and it was feared that our undersea craft would be unable to make the transatlantic trip unless towed part of the way by the submarine tenders, as the submarines' engines were continually in a state of repair and the fuel capacity of the boats was small. The K-boat division was put through an intensive repair period, including meticulous overhaul of the engines and renewal of the storage batteries.

Of the eight K-boats that had been overhauled for duty in the war zone, only four, the *K-1, K-2, K-5* and *K-6,* managed to get as far as the Azores.

The *K-1,* under the command of Lieutenant James R. Webb, and the *K-2,* under the command of Lieutenant E. M. Williams, left Brooklyn Navy Yard and put to sea for the war zone on the towline of the U.S.S. *Chicago,* while the *K-5,* commanded by Lieutenant E. D. McWhorter, and the *K-6,* by Lieutenant S. O. Grieg, started their ocean voyage on the towline of the tender, the U.S.S. *Bushnell,* during the latter part of September, 1917.

The small submarines were uncomfortable to travel on even in the smoothest of weather and when a storm came up and the towing vessels were forced to cast off their tows and let them shift for themselves, the little boats suffered so much that when they finally managed to limp into the port of Ponta Delgada, Azores, on October 27, 1917, they were unable to proceed any farther and carried on what war patrols they could in that vicinity.

The trip over had been such a strenuous one that a number of officers and men had to be transferred and given absolute rest for some time. The second officer of the *K-1,* Ensign Homer L. Ingram, tried to stick it out as long as possible and would only relinquish his duties when physically unable to stand on his feet any longer. He was sent home on sick leave, a mere shadow of the former 200-pound captain of a Navy crew and a football end that had sailed overseas just a few months before. Soon after his return he breathed his last.

None of the K-boats had any actual contacts with the enemy although they had the usual number of scares. The end of the war found them still in the Azores, able only to carry on a war patrol in that neighborhood.

The next division of American submarines to arrive in the war zone consisted of seven L-boats, the *L-1, 2, 3, 4, 9, 10,* and *11.*

Although they had their full share of adventures with the enemy and also our own men-of-war, none of them managed to bag a German submarine, although they had a number of opportunities and only failed by the worst breaks of luck.

On the trip across the Atlantic all the L-boats started on the end of a towline but such heavy storms were encountered that they soon had to shift for themselves. They all managed to arrive safely at the base at Berehaven, Bantry Bay, Ireland.

After receiving the latest submarine approach information from the experienced English submarine officers, all of our boats

put out on their weekly war patrols in succession.

When they were not busy trying to run down U-boats, they were endeavoring to get off a recognition signal to some American destroyer that preferred to fire first and ask questions afterwards. It would have been easily possible for some of our boats to have been sunk by our destroyers but all managed to come through without harm.

The *L-1*, under the command of Lieutenant R. A. Rood, had an excellent opportunity at an enemy ship. While on patrol on May 22, 1918, in sight of Pendeed Watch House Light and Long Ship Light, this vessel had her first encounter with a German submarine.

On this eventful morning the *L-1* had dived at daybreak, as was customary. About noon a German submarine was sighted on the surface at a distance of about 8,000 yards. Lieutenant Rood immediately maneuvered his submarine to place it in a good position for firing a torpedo. Estimating the course to be steered to gain that advantage, he went down to sixty feet and slowly stalked his victim, knowing that a slow speed was necessary, for the German boats were well equipped with listening devices.

At 2:35 P.M. the *L-1* again came up to periscope depth, about twenty feet, after having carefully located the target's position with the listening device. The U-boat was now seen to be at a distance of 2,000 yards, and was apparently of the *U-110* class.

At 2:52 P.M. the *L-1* had reduced the intervening range to 800 yards and at 2:55 two torpedoes were fired, one at the conning tower and the other at the bow of the German. The sudden removal of almost two tons of weight from the forward part of the American submarine caused the bow to broach, and the German immediately maneuvered to avoid the onrushing torpedoes, which he succeeded in doing. Before diving he fired four shots from the deck gun at the American, all shots falling clear of the target, although the men in the engine-room said that they had heard the fall of shots near their compartment.

The *L-1* immediately attempted to ram. Failing to make contact, she came to the surface and went ahead on the engines, broadcasting the location of the U-boat.

On July 27 at 10:40 A.M. a U-boat was sighted just as it surfaced. Before an attack could be made the enemy had disappeared; apparently, it had come to the surface only to enable the navigator to take a sun sight in order to fix his position on the chart. The German could be heard plainly but the American was unable to close in. An oscillator message was intercepted from the enemy, probably sent to the submarine working with him.

The *L-2*, commanded by Lieutenant E. A. Logan, also had contact with a German submarine, but in a most peculiar way. It was only by the merest luck that the American submarine was not blown out of the water.

On July 10, 1918, the *L-2* was en route to Bantry Bay on the surface. About six-thirty in the evening the lookout reported seeing something on the starboard bow which resembled a buoy and the *L-2* proceeded to investigate. A little later the submarine was suddenly shaken by a terrific explosion, lifting the stern almost out of the water; the lights in the boat were dashed out, the circuit breakers tripped, the engine-room floor plates were moved around, and the ventilation motors were thrown out of alignment. At the same time a large geyser of water was observed about sixty yards away on the starboard quarter. As the boiling water receded, about six feet of the periscope of an enemy submarine was observed, which soon disappeared. A periscope was then noticed on the other side of the *L-2*. The American submarine immediately dived and tried to ram the other U-boat but was unable to make contact, although the high-speed propellers could be plainly heard in the listening device. The second U-boat sent out oscillator messages, trying to get an answer from the first, but no answer was received. The *L-2* tried to decoy the German by sending out an oscillator message with a high pitch but received no response.

Apparently, one German submarine had fired at the American boat and the torpedo had missed the target, had continued on its track, and had intercepted the other German, who was also about in position to sink the *L-2*.

The *L-4*, commanded by Lieutenant Lewis Hancock, later lost in the dirigible *Shenandoah*, with Lieutenants Garnet Hul-

ings and Kenneth R. R. Wallace, and Gunner Ard as junior officers, certainly had more than her share of experiences.

On March 20, 1918, about 4:00 P.M., while on patrol, something was sighted on the starboard bow which, at first, was thought to be Fastnet Light. It was then made out to be a ship, which almost immediately turned away at high speed. The ship now resembled a submarine and the *L-4* headed for it at full speed. At 4:45 P.M. about two feet of brown periscope was sighted three hundred yards on the starboard bow. The rudder of the *L-4* was put hard over and the boat passed over the spot where the periscope had been seen.

The *L-4* then dived and the periscope was kept training about the horizon. Nothing was seen, although the propeller sounds could be heard very distinctly, showing that the German was only a short distance away.

The first loud propeller sounds were heard astern of the *L-4* and course was changed to bring the sound abeam. After this was done, course was again changed to bring it dead ahead. The sounds of the German propellers could be plainly heard in the American submarine without the use of the listening device. Just as the *L-4* swung around to place the German ahead of it a distinct jar was felt throughout the boat. Lieutenant Hulings, who was in the torpedo room, reported that the shock was plainly felt in that compartment and it is only reasonable to suppose that the two had made slight contact while submerged. The German possessed more speed than the American and finally drew away and out of hearing distance.

On April 12, 1918, at 8:00 A.M. propeller noises were detected and at nine-twenty a large German submarine was seen on the surface at a distance of one thousand yards. The enemy had apparently just come up, as his bow was well up and his stern still awash. As there was a considerable bow wave ahead of the U-boat, the *L-4's* commander judged that it was making its best speed and gave credit to his belief when the torpedo was fired. Hardly had the torpedo left the tube when the U-boat started down. The torpedo made a straight, fast run and was seen to pass just ahead of where the U-boat had been, the shot missing the target due to overestimating the enemy's speed. The U-boat's conning tower was seen a little later and an effort was made to ram it, but the *L-4* could not get close enough. The American then trailed the German for two and a half hours by means of the listening device, and then abandoned the chase.

On April 24, about 5:00 A.M., in bright moonlight, a vessel was made out on the surface on the port bow of the *L-4*. The boat was seen to be a submarine and, as it was heading directly for them, the range rapidly closed, the distance soon being one thousand yards. A moment later the German changed course, exposing his full left side, but at the same time he commenced to dive, evidently sighting the American. The *L-4* fired a torpedo at a range of two hundred yards and watched the steel missile of destruction as it leaped toward its target. The torpedo made a perfect run and a trail of bubbles was seen just forward of the conning tower. Nothing happened, however, and it was never known whether the torpedo passed under the German or hit without exploding.

On April 26, a little after midnight, a vessel, thought to be a submarine, was sighted. The *L-4* fired two torpedoes at it; the first passed under the target, while the second ran around in circles, almost hitting the *L-4* during its erratic run. The target was then seen to be a friendly surface vessel.

On May 18, 1918, the *L-4* was almost lost with all hands on board and, incidentally, set a record that stands today for deep submergence of a submarine.

About 8:40 A.M. the submarine was on a submerged patrol, traveling at a depth of twenty-five feet, at a very slow speed, on the "half switch," to use submarine phraseology. After being submerged for some time, water began to creep into the boat through the sea valves and it was desired to lessen the weight in the vessel by taking water out of one of the variable tanks.

For this purpose the submarine had a small tank in the center of the ship, then called "adjusting" tank, with a capacity of about one thousand pounds of sea water. The variable tank adjacent to it was called the "auxiliary" tank and had a capacity of about eighteen tons of water.

Lieutenant Hulings, then on watch in the central operating compartment, desiring to rid the tank of water by sending compressed air into it, gave the order:

"Blow the adjusting tank!"

The man on the air manifold, not as experienced as he might have been, mistook the order and thought that the word had been:

"Open the auxiliary tank,"

And thereupon he proceeded to do it.

In the meantime, Lieutenant Hulings had stopped the motors and ordered the storage batteries to be hooked up in "series," as he would then be able to get more speed by this means. He then looked at the adjusting tank gauge to note the exit of the water from that tank. His attention was called by the man on the diving planes by "She is settling fast, sir!"

Lieutenant Hulings then noticed that his order had been misunderstood and made every effort to rectify the mistake, but so much weight had been added to the boat, and the boat was going so slow, as the motors had been stopped, that she dropped like a rock and hit the bottom at 294 feet. The boat had only been designed and tested for 200 feet.

The chart showed that there was a depth of water in that vicinity of fifty fathoms, or three hundred feet, and that the bottom was soft mud.

The submarine was now too far down to attempt blowing the water out of the ballast tanks by means of air, as the added pressure would undoubtedly carry away the already strained hull.

First, the motors went ahead at one-third their maximum speed and an attempt was made to plane the boat up. But it refused to leave the mud. Next, two-thirds speed was tried with the same results.

The ballast pumps were designed to pump water out of the boat at depths up to three hundred feet. The high-pressure ballast pump was next placed on the forward ballast tank, all valves outboard on the tank being closed first. The pump could not take a suction as the circuit breakers tripped at the set amperage. The amperage on the breakers was doubled but still they refused to hold. They were then set for the maximum possible under any condition. For a few minutes the pump functioned and then the breakers tripped. The pressure in the tank had, however, been reduced from 127 pounds, the sea pressure at that depth, to 90 pounds. The pumping was discontinued as the motor was extremely hot, and the flanges on the pump discharge overboard valve were leaking badly, as was also the pump.

Backing the main motors was next resorted to, in the hope of breaking the suction of the soft bottom, but without success.

The small adjusting pump was then tried on the adjusting tank but after seven hundred pounds had been pumped out the fuses on the power line blew out as fast as they were put in.

The adjusting tank had been designed to withstand great pressure, so this tank was filled with water three times from the auxiliary tank and blown empty with high-pressure air. The bad feature of this method was that after each blowing the tank had to be vented into the boat before it could be refilled. A great pressure was soon built up within, so much that the needle on the barometer, used in a submarine to record the pressure, was bent up hard against the top of the instrument.

There are two ways of reducing the air pressure in a submarine while the boat is submerged. First, by pumping bilges until the water is out, after which the pump takes the excess air through it. This method is not advisable in time of war because the air bubbles and oil slicks can be detected by surface craft and the position of the submarine disclosed. However, the pumps on the *L-4* were not functioning, so this method could not be used. The next method is to turn over the air compressors, which are connected to the main propeller shafts, and supply compressed air for the torpedoes and for blowing water from the ballast tanks. When air is compressed, heat is generated, and for that reason cooling coils surround the compression chambers. Before the compressor could be started the cooler shell would have to be opened to the sea so that the circulating water might enter the coils. The commanding officer realized that the shell would be subjected to a great pressure but decided to take the chance. The port compressor was started but had to be stopped almost immediately as the shell burst.

The stern tube glands on the propeller shafts began to leak badly although the crew set up on them as much as possible. Soon, the water began to fill the bilges in the engine- and motor-room and was mounting to the main motors. Different valves in the engine-room began to leak and soon little

trickles of water were in evidence throughout the compartment.

As the water level was rapidly approaching the main motors the commanding officer knew that something had be to done before they were permanently disabled, or they would remain on the bottom forever. He had every man except those on the necessary diving stations go as far aft in the boat as possible, with the idea of lightening the bow. Pressure was then put in the forward ballast tank until the safety valve on the air line blew; it was then reset at 15 pounds above the sea pressure, or at 140 pounds, considerably above what it had been designed for. The main motors were then sent ahead at two-thirds speed, the chief electrician on the submarine coolly holding the circuit breakers closed, despite the fact that his arms would probably be burned badly.

The bow rose to a three-degree angle but held fast in the mud. Slowly it tilted to six degrees, then suddenly broke loose. The *L-4* headed for the surface at a very steep angle—approximately fifty degrees. At one hundred feet the middle main ballast tank was blown and a moment later the boat was on the surface, having been on the bottom for one hour and ten minutes. The after main ballast tank was left filled in order to keep the water in the bilges from coming over the floor plates and wetting the main motors, as the water was only three inches from them before leaving the bottom.

In a report on the accident, the commanding officer said:

> I cannot too highly praise the behavior of the personnel, both officers and men. Although every one realized that the situation was extremely serious, there was not the slightest evidence of panic or excitement. Every man stood by his station in as calm and efficient a way as if an ordinary drill was being conducted.

As the result of this accident the name of the adjusting tank was changed to regulator tank and the lever handle operating the auxiliary tank was painted a different color from the others and was kept locked or pinned down.

There were any number of instances when, while out on listening patrols, the L-boats heard a depth charge from a distance and soon afterwards heard the U-boat hurrying away. On every occasion effort was made to intercept the enemy but without success.

On the same day that the *L-2* had her unusual experience with the two German submarines, the destroyer *Allen* opened fire on her despite the fact that the *L-2* was making recognition signals and waving flags. The *Allen* only ceased firing when a range of two thousand yards had been attained. Some of the shots fell alongside the *L-2* but, fortunately, none hit her.

Some of our officers were sent out as observers on the British submarines. On March 7, 1918, the submarine service lost a brilliant officer, Lieutenant Earle W. F. Childs. This officer had gone out on the British submarine *H-5* for instruction purposes and was lost with it when the boat was destroyed by the enemy.

The *L-10,* commanded by Lieutenant Commander James C. Van de Carr, was almost destroyed by depth charges by one of our own destroyers. On March 25, 1918, about 5:50 P.M. a destroyer was seen approaching through the periscope of the *L-10,* and it was recognized as being the U.S.S. *Sterett,* commanded by Lieutenant Commander Simpson, the Naval Academy roommate of the *L-10's* commanding officer. As it was not desired to surface at the time, the *L-10* planed down to sixty feet, with the idea of letting the *Sterett* go by. The propeller sounds could be heard getting closer and closer, and suddenly the submarine was shaken violently from stem to stern, throwing the lights out in the boat and jarring many things loose. The *Sterett* then threw over a buoy and proceeded to lay a barrage of depth charges around her proposed victim. The *L-10* was being shaken badly and threatened to burst after each explosion. As the *Sterett* reached the outer ring of the barrage circle, the *L-10* was quickly surfaced and the recognition signal got off before the destroyer could open fire with the deck guns.

The *Sterett* then came close aboard and held a conversation with the submarine commander:

"Your oil tanks are evidently leaking as I spotted you by the oil slicks. You are lucky I misjudged your position. Are you all right now?"

Van de Carr shouted back:

"All right now, Buck, old boy, but almost scared to death."

The destroyer commander then shouted over a parting admonition:

"The *Trippe* will be up here in about an hour. You had better remain on the surface until she gets here. So long."

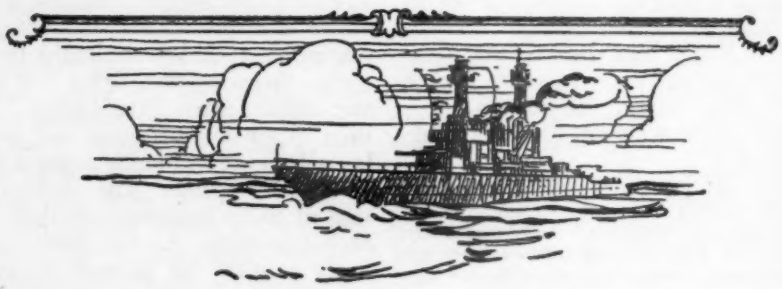
An hour later another destroyer, presumably the *Trippe*, appeared over the horizon, and although the American flag was being waved on the submarine and the recognition signal was being made periodically, the destroyer fired six shots, three going over, three falling short.

Commander Van de Carr then radioed his famous message to the *Trippe:*

"Three over, three short, deflection fine!"

The *L-11*, commanded by Lieutenant A. C. Bennett, came very close to scoring our only hit of the war so far as our submarines operating in the war zone were concerned.

On May 11, 1918, while on a submerged listening patrol, a U-boat was sighted on the surface at a distance of about six thousand yards, bearing on the *L-11's* port quarter. The American slowly swung around to a firing position and reduced the firing range to nine hundred yards. Two torpedoes were fired at an interval of five seconds. The first one broached. A terrific explosion was seen to take place about two hundred yards from the enemy submarine as the torpedoes exploded and it seems only probable that one torpedo overtook the other and caused the premature explosion. The U-boat dived and was not seen again.



The Church Pennant

By LIEUTENANT A. R. MCCRACKEN, *U. S. Navy*

LIKE many other naval customs the use of a church pennant was probably inherited from the British Navy. A British signal book of 1796 describes the church pennant as "a common British pendant" but does not illustrate it. The instructions state that the pendant is flown from the mizzen peak "to denote that the Ship's Company are at prayers." Further, when flown from the ensign staff it denoted "that a man is fallen overboard." It is hoped that in those rough and hardy times this original use of the church pennant was not a sarcastic jibe at the unfortunate victim in the water. A later British "Signal Book for the Ships of War" (1799) contains the same instructions and in addition illustrates the church pennant by means of a water-color drawing. This design is similar to that used in the British Navy at present. (See sketches.) It is interesting to note that it is still used to indicate man overboard (from a different point of hoist than the above), as well as during divine services.

In an effort to trace the use of the church pennant in the United States Navy all available signal publications have been consulted.

The early pamphlet form of signal book for the use of individual squadrons (1807 and 1812 editions) makes no mention of the church pennant; neither does "A Code of Signals, by David Porter, Commanding Naval Officer, New Orleans Station, Adopted there by authority of the Navy Department, 1800"; nor does the first Navy Department signal book for general use, "Signals for the Use of the United States Navy as adopted by order of the Navy Department, August, 1813." However, the church pennant probably existed long before 1844. There is said to be on file a requisition of that date from a certain commanding officer for a church pennant. As there are available no signal books from the period 1813 to 1858 the original design and use of the church pennant are unknown. In the signal book of 1858 appears the earliest illustration of the church pennant which has been located to date. As shown it is a blue Greek cross on a white pennant. (See sketches.) However, there is no text to describe its use or point of hoist. An error of contradiction exists in a French flag book, also printed in 1858 ("Album des Pavillons, Guidons, Flammes de toutes les Puissances Maritimes") which illustrates, on the U. S. Navy page, a church pennant bearing a blue Latin cross, with the long arm horizontal and the short arm extending clear across the pennant. (See sketches.)

In the "Code of Flotilla and Boat Squadron Signals for the U. S. Navy, 1861," the illustration appearing in the Signal Book of 1858 is shown (blue Greek cross), but again without explanatory text.

Also at this time there exists in "Signals for the Use of the Navy, Confederate States, 1861," an illustration of a church pennant bearing a red Latin cross, long arm vertical, on a white pennant, but there is no text explaining its use. (See sketches.)

The earliest record of the actual use of the church pennant is in a general order of Admiral Farragut, appointing an hour of thanksgiving.

U. S. Flagship *Hartford*

Off the City of New Orleans, April 26, 1862.

Eleven o'clock this morning is the hour appointed for all the officers and crews of the fleet to return thanks to Almighty God for His great goodness and mercy in permitting us to pass through the events of the last two days with so little loss of life and blood.

At that hour the church pennant will be hoisted on every vessel of the fleet, and their crews assembled will, in humiliation and prayer, make their acknowledgments therefor to the great Dispenser of all human events.

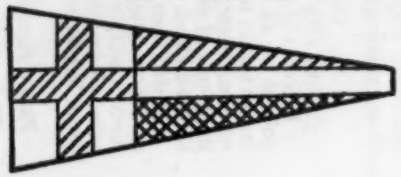
D. G. FARRAGUT,
Flag-Officer Western Gulf Blockading Squadron

This order does not specify the point of hoist nor the manner of flying the pennant,

CHURCH PENNANTS

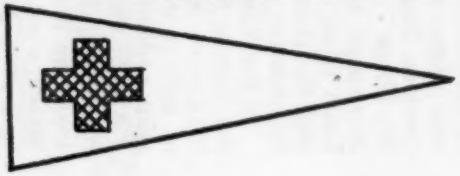
RED WHITE BLUE

BRITISH
(ST. GEORGE'S CROSS)



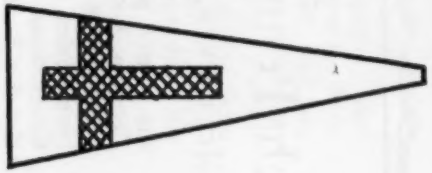
SHOWN IN BRITISH BOOK 1799

U.S.N. 1858 – 1883
(GREEK CROSS)



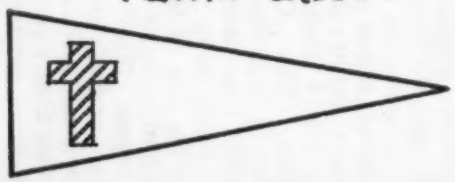
AS SHOWN IN SIGNAL BOOKS

U.S.N. – 1858 ?
(LATIN CROSS)



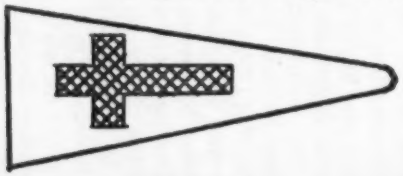
AS SHOWN IN FRENCH BOOK

CONFED. STATES 1861
(LATIN CROSS)



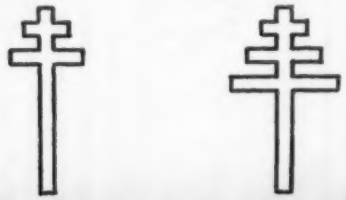
AS SHOWN-IN C.S.SIGNAL BOOK

U.S.N. 1908 TO DATE
(LATIN CROSS)



AS SHOWN IN SIGNAL BOOKS

OTHER CROSSES



PATRIARCHAL PAPAL

armc.

indicating a commonly understood knowledge of current practice, whatever it may have been. The "Signal Code of the U. S. Navy, 1864," contains neither a plate nor text concerning the church pennant, but in the signal book of 1867 is found the first record of instructions: "The Church Pendant will be hoisted immediately above the Ensign at the peak or flagstaff at the time of commencing, and kept hoisted during the performance of divine service on board all vessels of the Navy." Although the first printed instructions are contained in this book, the plates (which are dated 1866) do not include an illustration of the church pennant.

"The Naval Signal Book of the United States of America, 1869" illustrates the church pennant with the blue Greek cross, and under the plate is found the following: "To be hoisted at the peak above the Ensign during the performance of Divine Service." This is amplified in the text by repeating the instructions in the 1867 book, excepting that the word pennant is used rather than pendant.

The "General Signal Book of 1876" uses the same plate as the 1869 book with the note below the illustration, but the text states that the church pennant will be hoisted above the ensign during the "continuance" of divine services on board all vessels of the Navy.

Another copy of this book with new plates, dated 1883 and pasted in, shows the church pennant still bearing the blue Greek cross, but a curious error was published in 1872 in Captain Preble's book *Our Flag*. He states that the "Church pennant is a white pendant without swallowtails charged with a blue Latin cross, to be hoisted at the peak, during divine services, over the ensign, the only flag to which the national ensign shows such submission." Although the above quotation states that the cross is a Latin cross the available signal books preceding and following 1872 show the pennant with a Greek cross, and contradicting its own text, the illustration in *Our Flag* also shows the Greek cross. It is to be noted that none of the signal books state in the text what type of cross is used but all illustrations up to this time show the Greek cross, except the plate appearing in the French flag book which cannot be considered authentic when it does not agree with our own official publications.

From 1883 to 1898 no signal books are available. The "General Signal Book of the United States Navy, 1898" does not illustrate the church pennant, but states: "Church Pennant. This pennant is to be hoisted over the ensign during the performance of Divine Service on board of every ship in the Navy."

Another gap in the record follows, until the "General Signal Book of the United States Navy, 1908," which shows the church pennant bearing the present blue Latin cross (see sketches) and the text, quoted: "The Church Pennant is to be hoisted over the Ensign during the performance of Divine Service on board vessels of the Navy."

The "General Signal Book of the United States Navy, 1913," also shows the present blue Latin cross, with the following text: "The Church Pennant shall be hoisted at the same place of hoist and over the ensign during the performance of Divine service on board vessels of the Navy," still in effect, appearing in the "Signal Manual, 1920."

Thus, two facts are not known about the church pennant, one of design and one of use. The date and reason for changing from the Greek to the Latin cross is indeterminate. While it may have been that the design of the Latin cross lent itself more decoratively to the shape of a pennant, it is, according to Webster, "the chosen symbol of Christianity", and those who are in doubt concerning the church pennant should not confuse the Latin cross with other crosses of more limited symbolism, such as the patriarchal cross, the papal cross (see sketches), or the hundreds of other forms of cross which exist in heraldry. As used in the Navy the church pennant is of course entirely nonsectarian. It merely indicates that church services are actually in progress and the same pennant is flown regardless of the particular denomination which the chaplain may represent.

The origin of the practice of flying the church pennant above the ensign is also lost in antiquity, but as the printed records are available from 1867 on, the custom may be considered as a time-honored one. It is not impossible that in initiating this custom, the pious, though often plain-spoken seamen of preradio days, realized, as they tossed in cockleshells during a terrific storm, that guidance and deliverance, if any, would come from Divine hands and not from organized governments.

Behind *the* Flying Lines

By LIEUTENANT COMMANDER L. C. STEVENS *(C.C.), U. S. Navy*

THOSE who fly airplanes are not overfond of getting the maximum performance out of "ships" that have piled up their flying hours well into the hundreds since overhaul. The control sticks are loose and wobbly in their bearings, and the stabilizers are either too hard to roll or work with suspicious ease. The landing gear of landplanes rattles on taking off and landing, and the whole structure of seaplanes begins to feel loose. The fabric covering the surfaces is dead, and the planes feel heavy. Engines begin to use more oil than they should, and do not run so smoothly. Even when an engine is pulled and replaced by a new one, vibration is greater. You can shake the wings and tail and feel them rattle. Everything seems to be wearing—not enough to warrant replacing any particular part, but just enough so that one does not pull back so heartily on the stick when coming out of a dive, and so that one would a little rather have a plane with a little less time for a long cross-country or cross-water trip.

The worst thing is the uncertainty of the things that can't be seen. Parts of fuselages and hulls that can be opened up have been cleaned and refinished two or three times as opportunity permitted. One would like to put the plane out of commission and have a look at everything, just to make sure. The small amount of corrosion that is found whenever a couple of weeks are available for opening things up is just enough to indicate that there is probably more deterioration going on elsewhere—inside the wings, underneath the lower longerons, around the keel plating, everywhere where the real vital strength of an airplane resides. There is not time in a tight gunnery schedule, a concentration period for the development of tactics, or a long cruise, to lay the planes up for the work one would like to do. The squadron must be kept full in order to meet the schedules and to avoid the heavy penalties of planes out of commission during gunnery, and the spare planes must be kept as stand-bys and used to replace crashes.

It seems as though the vitals of an airplane are the very parts that are covered up the most. The little dents and worn and broken places that one can see are not so bad. You at least know what to expect from them, and handle the plane accordingly. Nearly everyone, though, has seen some amazing things in the way of deterioration when things were really opened up. It is only an occasional plane that gets that way. It doesn't happen frequently enough to warrant shortening schedules to do more upkeep work in the squadrons. Still, if a pilot rolls the wings off a plane with several hundred hours flying time since overhaul and lives, he is apt to hear some unkind remarks passed on his lack of judgment in treating such a plane in such a manner.

The Air Station at San Diego has helped considerably by installing fuselage covers that lace so that the entire bottom of a fuselage can be opened up. Then one can have a look, and can take preservative measures without knocking off all other work for the occasion. It's too bad they can't devise a bottom for a big boat that will snap on, or wing coverings that can be hinged up. They could, were it not for the weight involved. But even then, it wouldn't put the air stations and overhaul bases out of a job, for this is only one feature of a major overhaul.

The time that planes should be kept in service before sending them to major overhaul cannot be worked out from a formula. So much depends on the ever-changing types of construction (that indicate progress in design and consequently improvement in performance), on the service to which the planes have been put, on the varying opportunities for maintenance in the squadrons,

and on the technical skill of the operating personnel. Administrative considerations also enter into the problem. It may sometimes be best to overhaul planes a little sooner than one would like in order that they may be ready for a cruise in good shape, or it may be desirable to feed in a few planes in order to keep the overhaul base from becoming disorganized. Some types of planes under some conditions of service need overhaul badly at the end of 250 hours, and others can go for 500 hours and, short of accident, still be in fairly good condition. No one, with the means to do otherwise, would think of driving an expensive automobile year after year without laying it up in the shop for a general inspection, repairs, and tuning up. Apart from considerations of safety, economy of naval material requires similar periods for expensive airplanes. The average naval airplane, built to low factors of safety, is in the air and is operating under far more difficult and severe conditions, about as many hours per year as the average automobile is on the road.

The reconditioning of naval planes differs in one important respect from the overhaul of commercial aircraft. Design changes are always found necessary and desirable as a type of airplane acquires use in service. It is only possible for the squadrons to incorporate those changes that are imperative for safety or for the military use of the planes as intended. Other changes, many of them of a nature that will lengthen the service life of the airplanes, must accumulate until a well-equipped base can accomplish them, usually during major overhaul when the concealed parts can be got at and worked on.

The central design section of the Bureau of Aëronautics, and through that section, the civilian designers and builders of the airplanes, are dependent upon the overhaul bases for reports and recommendations regarding design features that affect maintenance and very frequently structural strength. A great many of the design changes on various types of planes have originated at the bases, and often, due to the lack of availability of airplanes or drawings elsewhere, the specific methods of incorporating design changes are best determined there. The bases also provide a reservoir of experience in various shop processes, technique, methods, and special equipment. An attempt is consequently made to keep personnel there who are as far as possible qualified in design training and experience. That that personnel should also be qualified in airplane operation goes without saying, for they should have as broad a viewpoint as possible towards the material with which they work, and should merit the unqualified confidence of the operating personnel in their methods and decisions.

When an airplane is taken into the shops of the San Diego station for major overhaul, it is completely disassembled by a shop that does nothing else. And this means disassembled, for every part that will come apart is taken apart. The fabric is stripped from the wings and control surfaces; the engine is removed; the landing gear and tail-skid assembly removed and disassembled; struts, wires, engine, and surface controls taken out; cowling, fairing, and instruments removed; and all the hundreds of parts that are bolted or screwed to the skeleton fuselage frame put in boxes. Every part is tagged with a small copper burr bearing a number assigned to that particular airplane.

The necessity for such complete disassembly is twofold. First, a thorough inspection is impossible without removing all the parts that would otherwise make inspection difficult, if not impossible, and second, a proper paint and finish job cannot be done on assembled parts, and the life of a plane depends largely on its protective finish.

The fuselage, or hull, being, so to speak, the backbone of the plane, is scheduled through the shops to final completion, an estimate of cost and time having previously been made before the plane is taken into the shops. The wings, floats, and other parts that join on to the fuselage are scheduled to meet the fuselage as necessary, and due allowance must be made for the work load on the various shops and the personnel that will be available to do the work.

After disassembly the skeleton fuselage and all the little parts are cleaned. Everyone knows that a clean surface is the secret of a good paint job. Steel fuselages and parts that are not too soft or fragile are sand-blasted to a beautiful satin finish, and are immediately given a priming coat of paint, for otherwise they would begin to oxidize and deteriorate overnight. Steel

grit is used for the blasting material on steel parts that are heavy enough to stand this treatment, rounded beach sand under low pressure on other parts, and hand cleaning on still others. Duralumin fuselages made up of complex built-up structures are not sand-blasted, but are cleaned by brushing with mild cleaning compounds that will not injure the soft duralumin. Parts that do not contribute to strength, such as cowling and fairing, are immersed in tanks and cleaned chemically.

At this point it is possible to eliminate the greater portion of parts that are beyond repair. After cleaning away the dirt, rust, and corrosion, a decision can be made as to whether reënforcement and strengthening can be economically employed. Most of the fuselages that must be stricken from the Navy list because of deterioration wind up their naval careers at this point.

The usual run of fuselages or hulls are then repaired. Broken longerons and other members are spliced or replaced; dents, kinks, and deformations that weaken the strength are reënforced, usually by welding, and the entire structure made sound throughout. All elongated holes for the attachment of wires, fittings, and assemblies are brought back to their original tolerances by filling with welded metal and redrilling, by reaming and bushing, or by replacement of parts, which usually have to be manufactured in other shops for the purpose. The use of oversize bolts and pins is avoided as far as possible in order that all parts may be interchangeable in the field. The brace wires are put back in, and the fuselage straightened and aligned. At this point fuselages are occasionally found to be beyond repair, as they are sometimes distorted and warped so that they cannot be brought back to their former accuracy of shape, even with the application of heat. If they are not properly aligned, the wings and control surfaces cannot be finally assembled so that the plane will be in proper aërodynamic balance.

Meanwhile repair has been made of all the minor parts. Bent members are straightened and reënforced and improvements incorporated. They are painted and as good as new in both strength and appearance by the time they are ready for replacement in the fuselages. Certain parts such as control wires and electrical wiring are always renewed. Steel bolts and fittings are cadmium plated in order to increase their resistance to corrosion and to insulate them against electrolytic action when in contact with dissimilar metals. Holes for pins and bolts are brought back to their original dimensions. Certain parts, depending on the design of the airplane, require heat treatment if they are made up new or if it has been necessary to apply heat in repairing them. All the parts that have been distributed throughout the various minor shops for repair and reconditioning come back to the plane from which they were originally taken. It is only when one sees the complexity of a modern fuselage and the diversity of types of airplanes that are overhauled at San Diego that the necessary experience and skill of the mechanics can be realized.

The last things that are put back in the fuselage or hull are the tanks, piping, and wiring. The tanks meanwhile have gone through the same process of cleaning and repair, and a special technique must be developed and maintained for this work as for nearly every other branch of airplane overhaul work. During the repair of the tanks themselves it is necessary to remove fittings, strainers, gages, etc., and send them all to different shops that specialize in the particular class of work, and get them back to the tanks from which they came at the proper time for assembly and installation.

The fuselages are then covered and doped, and are now ready for final assembly. Meanwhile the wings have been overhauled. Repairs are made to the internal structure of the wings, spars spliced, ribs replaced, or damaged members reënforced in order that the original strength may be restored in every respect. Fabric covers are stitched, slipped over the surfaces, rib-stitched, and secured in place, and finally doped to the proper condition of tautness. Control surfaces must be handled in the same manner, and all wear and play removed from hinges and attachments. The art of a skilled metal smith is so different from that of a woodworker that wooden wings have to be handled by entirely different personnel from metal wings. Minor parts of wings frequently have to be handled in other shops, as in the case of repair of a fitting, which may involve sheet metal work, welding, machining, plating, and finally painting before it can be replaced in the wing from which it came.

Everything else that goes into the final installation is similarly handled. A special shop repairs and reconditions wheels, another works on flotation bags, still others on magnetos, radio, batteries, and fire extinguishers. Landing gear and external struts must be made to fit their attachments without play or lost motion. Flying and landing wires must be reconditioned or replaced. Corrosion must be arrested on floats, and members that show signs of corrosion reënforced or replaced.

Since the engines carry their own logs and histories with them, no effort is made to put the same engine back into the plane from which it came. The overhaul of engines is scheduled on a productive basis and kept separate from the airplane schedule. The engines, like the airplanes, are first disassembled. Ignition wiring and spark plugs are removed, and carburetors and magnetos taken off and sent to separate shops for further disassembly, cleaning, repair, and replacement of parts. Cylinders are taken off and sand-blasted. Crank cases are disassembled, pumps and other assemblies removed, and the pistons and rods broken down. After cleaning, new bushings and pins are inserted, journals stoned down to the original tolerances, crank shafts straightened, valves re-cut, and other repairs and replacements made as necessary to bring the engine back to its original clearances. Even the spark plugs are disassembled and reconditioned. Parts return to the same engine from which they were taken, and the minor and major assemblies are put together until the engine is again complete.

The engine is now put on the belting-in stand, where it is turned over by external power to work in the moving parts without imposing the additional stresses due to heat and power. It is then placed on the test stand and carefully run in and its functioning checked. Special test propellers are used in order that full power may be developed and the engine still kept cool. When finally found to be satisfactory, it is greased for preservation and sent to store. Like the airplanes, the engines are brought back to their original condition insofar as it is posssible to do so, and in some respects, particularly when changes have been incorporated, the overhauled engines, like the planes, are even better than new.

When the entire airplane is finally assembled, the work is again specialized. The crews that install the engines cannot be expected to rig and align the wings and tail surfaces. The flotation gear is installed by a special crew, and tested to see that the bags inflate properly and evenly. Recharged bottles containing the gas for flotation are put in. Cowling is also installed by a separate crew, for there is always a considerable amount of straightening, cutting, and trying connected with a neat cowling installation. When the plane is completed, the engine is turned up on the beach to check the functioning of the fuel and oil systems, to insure that there is no harmful vibration, and to give the engine itself further time to work itself in. Finally the airplane is looked over and checked by the officers under whose supervision the various parts of the overhaul have been accomplished.

Then the airplane goes on the line for flight test. Here any errors in alignment, balance, and general functioning are finally found by actual test and corrected. The plane is flown again and again until it is satisfactory as an airplane in all respects. During this time it is impossible to avoid getting a certain amount of dirt and oil on the plane. The final coat of finish is consequently not applied until after the completion of flight tests, and when the airplane is delivered to the operating units it is spick and span in appearance and known to be sound throughout.

Few naval officers, even those who are in aviation, who have not been connected with modern overhaul work, realize how careful and thorough a job of reconditioning can be done. Most officers do know, however, that accident statistics in the Navy show that the work is well done, and that the necessary technique and knowledge is increasing. It has to increase, for new materials, requiring familiarity with new processes, are continually coming into use. A few years ago duralumin was unknown and cadmium plating had not been applied to aircraft. The use of welding is widespread in airplane design, particularly with chrome molybdenum steel, but the welds must be made with extreme skill, for there is no excess factor of safety to fall back on. Today the use of duralumin sheets covered with a thin layer of aluminum is commencing, which will necessitate further increases in repair

technique to keep pace with the new materials. The anodic process for protecting duralumin from corrosion is being adopted and stainless steel is finding a wider application. Shop equipment and tools must also keep up with commercial developments outside of the Navy. Tungsten carbide drills, semi-automatic hand tools, mechanical drawbenches, and many forms of special equipment make it possible to do work that previously was out of the question, and make possible a greater output of work. Special tools and machines are developed at San Diego that eventually find a commercial application.

At San Diego there are an average of more than fifty airplanes going through the shops simultaneously in various stages of major overhaul. There are thirteen different types of airplanes being worked on in the shops at the present time. About forty engines of five different types are simultaneously in the engine overhaul shops. In order to accomplish this work, it is necessary to specialize the men into forty-four different shops. Many of these shops are again specialized within themselves, as in the necessary division between wooden- and metal-wing repair.

All of this work, including the upkeep and maintenance of shop tools and equipment, planning, scheduling, estimating, keeping track of progress, shop storerooms, supervising, transportation, testing, clerical work, obtaining of material, development work of all sorts, and all the other auxiliary functions, is done by a complement of about five hundred enlisted men, five commissioned officers, and two warrant officers. The tour of duty for enlisted men is two years, extended in a few special cases. Leave and the average amount of illness reduces the effective complement to less than 450 men, out of which must come supervisors and overhead of all sorts. The sort of lost time that is unavoidable in military organizations reduces each man's working time to less than thirty-five hours a week.

From the nature of the work that is accomplished, it is clear that the men must be specialized on their jobs. The man who has been taught how to control the temperatures of the heat-treatment baths for duralumin, and to support the work in the electric furnaces so that it will not warp during treatment, cannot be readily replaced by a man who has been installing complex parts in a certain type of fuselage, and the expert metal worker who has been splicing metal wing beams cannot be expected to shoot trouble on a lathe that is out of commission. The full two years of duty is barely enough to enable a man properly to perform his own particular job or operation. The experience that he gains is valuable, but it is only a limited sort of experience. After two years at the San Diego Air Station, a man who is an accomplished fabric stitcher, and who knows all the intricacies of the machine with which he works, must be sent to sea where the chances are that no stitching is ever done; or another, who has learned to weld chrome molybdenum tubular fuselages, goes to a squadron operating planes that do not even have fuselages.

Conversely the station, for a replacement metal-shop foreman, receives a chief who has been in charge of operating planes in a squadron. The turnover of labor is appalling. Not even the full two years of shore duty is available in most cases, for there was a turnover of more than 100 per cent at San Diego during the past year. A labor turnover of 50 per cent would put a commercial concern on the rocks, and make the supervisors gray-haired.

The repair stations have somehow managed to do their work under these conditions, and to do it creditably. They could continue to do it in the same manner in the future if it were not for certain changing conditions that have been foreseen which give rise to problems that are still unsolved. Perhaps the most important of these is the fact that naval aviation is still expanding rapidly. The five-year construction program authorized by Congress will be completed in another year. The Battle Fleet, which is served by San Diego, has been largely already cared for in this program. The number of airplanes throughout the Navy, however, is being increased, and those same airplanes must be overhauled and reconditioned somewhere. The outlying stations are now being built up with suitable airplanes, but already the facilities of San Diego are being called upon to overhaul airplanes for Pearl Harbor and the Asiatic Fleet. San Diego has not quite been able to take care of the requirements of the fleet alone in the past two years. The services of outside contractors and the shifting of work loads to other

stations are resorts that have already had to be used. Both methods of taking care of the excess of work are unsatisfactory.

Civilian contractors will do the definite items of work specified in the contract, but no more, unless the contract is modified accordingly. No contract can be drawn up covering the work found necessary on overhaul, because the nature of the work cannot be foreseen until a portion of it has been completed. Unless contracts are drawn up in so general a way that the costs would be prohibitive to the Navy, the Navy will be the loser in the thoroughness of the work performed.

The time element is of extreme importance in a military organization, and particularly so in short-lived airplanes. An airplane out of operating service means not only a loss in availability for operation, but a loss due to approaching obsolescence. When the five-year program is completed, there will still not be enough spare and reserve airplanes to put operating airplanes out of commission long enough to accomplish the overhauls at civilian plants, or to accomplish other than minor transfers to distant naval stations, not to mention the transportation charges and the work loads on the other stations.

The five-year program, moreover, will not complete the expansion of naval aviation. There is no question but that the addition of new carriers to the fleet will necessitate a further increase in the number of airplanes, and it is probable that additional planes will be needed for the program of cruiser building. The published policy of the Navy Department is to develop the application of airplanes to all types of surface ships. So far the application has been made to battleships and cruisers alone, and the extent to which airplanes can be put on board even those vessels is far beyond what has already been accomplished. Additional airplanes can be put to sea in far greater numbers than heretofore, even without the addition of new surface ship tonnage to the fleet. It is reasonable to believe that this will be done as fast as tactical and strategical considerations can absorb the additional planes.

The surface ships—even the great *Lexington* and *Saratoga*—cannot possibly take care of the major overhaul of their own airplanes. Neither space nor man power is available. The most that they can do is to carry spares of the major assemblies, such as wings, landing gears, control surfaces, engines, etc., compactly stowed in the small spaces that will be available; and to replace damaged parts with these spares, accumulating the damaged material for overhaul elsewhere. A real major overhaul cannot be accomplished on a combatant ship, and nothing less is acceptable for reasons of economy of both life and material.

Even a new design of carrier cannot be expected to take care of the overhaul of its own airplanes. We are already so limited by the provisions of the Washington treaty, and may be still so further limited by the London treaty, that it is imperative that every bit of available space on new carrier designs be put into stowage for operating airplanes. Space for spreading out disassembled airplanes and for the necessary shop equipment is not legitimate on combatant carriers. A double penalty would be incurred in the living, messing, and berthing space and tonnage for the additional personnel to accomplish the overhauls, and the designers are hard put to find space for the operating personnel on carriers as they are now conceived.

Relief must be sought in several directions. The aviation repair facilities of the *Medusa*, the *Vestal*, and such general fleet repair vessels, can be expanded, but not to any considerable extent without interfering with the other functions of those ships. Aviation fleet repair ships, designed solely for that purpose, can eventually be built, but they are a long way in the future, will cost a great deal of money, and will require a large overhead in naval ratings other than aviation to operate them. The effectiveness of such vessels as compared to a shore base will necessarily be low, due to their inherent limitations of space, transportation, accessibility to supply markets, testing facilities, etc., but they appear to be an eventual necessity for reasons other than taking care of part of the total work load.

Meanwhile the necessity for increasing the output of existing overhaul bases is already upon us. Much can be done at San Diego and elsewhere in expansion of output. With the short tours of duty of the enlisted workmen and the tremendous labor turnover, far less can be done than if trained men could be retained to make use of their training.

The use of civilian labor to replace the enlisted personnel has been suggested. Unless the total enlisted force of the Navy is substantially increased, this will be an ultimate necessity. The objection that the enlisted personnel would lose valuable training is easily met by the fact that their training in a modern overhaul base is necessarily so specialized that it is of little value elsewhere—even of little value in any other job on the same base. There are, however, other better-founded objections, such as that desirable shore billets for enlisted personnel would be eliminated, and that legislation, with increased cost to the naval budget, would be necessary. It appears that the increased cost can hardly be avoided. More and older airplanes can scarcely be overhauled at a reduction in total cost.

In the meantime, two partial solutions have been suggested that would considerably ease the situation. One of them is to extend to three years the shore duty of the enlisted personnel at the overhaul bases, and to four years or more the shore duty of the key personnel—shop supervisors and highly specialized chief petty officers whose duties require an unusual amount of experience. The other is to make use of the sixteen-year men by reënlisting them for duty on their station, either making them extra numbers so as not to unduly retard promotions, or recalling them to active duty in the Fleet Reserve. These measures would make it possible to develop methods that would expand the output of work now obtained, instead of dissipating time and energy in going over old ground with new and untrained personnel. The rate of output will naturally increase with total experience, but its rate of increase would be considerably accelerated by making fuller use of what experience exists. These suggestions also have the merit of being the least expensive palliatives that can be applied, viewed from the very practical standpoint of dollars and cents.

The airplane overhaul bases take great pride in the part that they have had in establishing the enviable record for safety enjoyed by aviation in the Navy, and in the economical manner in which they have done their work. Under no circumstances can their standards of workmanship be lowered. Their work, which is done under difficulties, is increasing, and can be expected to increase in the future. Either more money or more men with which to do that work must eventually be forthcoming. In the meanwhile, minor changes in policy will go far to enable them to keep up, and to retain the well-merited confidence that the aviators in the fleet have in the condition of their overhauled engines and airplanes.

BOEING F4B1, NAVY FIGHTER

Courtesy Boeing Airplane Company

Courtesy Boeing Airplane Company *United Airport Photograph*

ONE OF THE WORLD'S MODEL AIRPORTS

United Airport, Los Angeles, a subsidiary of the United Aircraft and Transport Corporation, is developed to A-1-A Department of Commerce standards for par excellent airports. It is an all-way field with five surfaced runways averaging 400 by 3,500 feet. The 4,000,000 feet of paving is equivalent to a 30-foot surfaced highway 25 miles long. It is developed as a complete aëronautical unit and is the southwestern base of operations for the Boeing system.

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Courtesy the National Air Transport, Inc.

PARACHUTE DROP-TESTING DEVICE ATTACHED TO N.A.T. PLANE
The dummy is the size and weight of the average pilot.

Courtesy Pratt & Whitney Aircraft Company

SOME OF THE SIXTY-NINE HORNET-POWERED MARTIN BOMBERS TAKING PART IN THE AERIAL MANEUVERS OFF THE VIRGINIA COAST
They are lined up on the deck of the *Lexington,* ready to take off. These planes are sent off at ten-second intervals and during the three-hour demonstrations made attacks on the *Lexington* from the air.

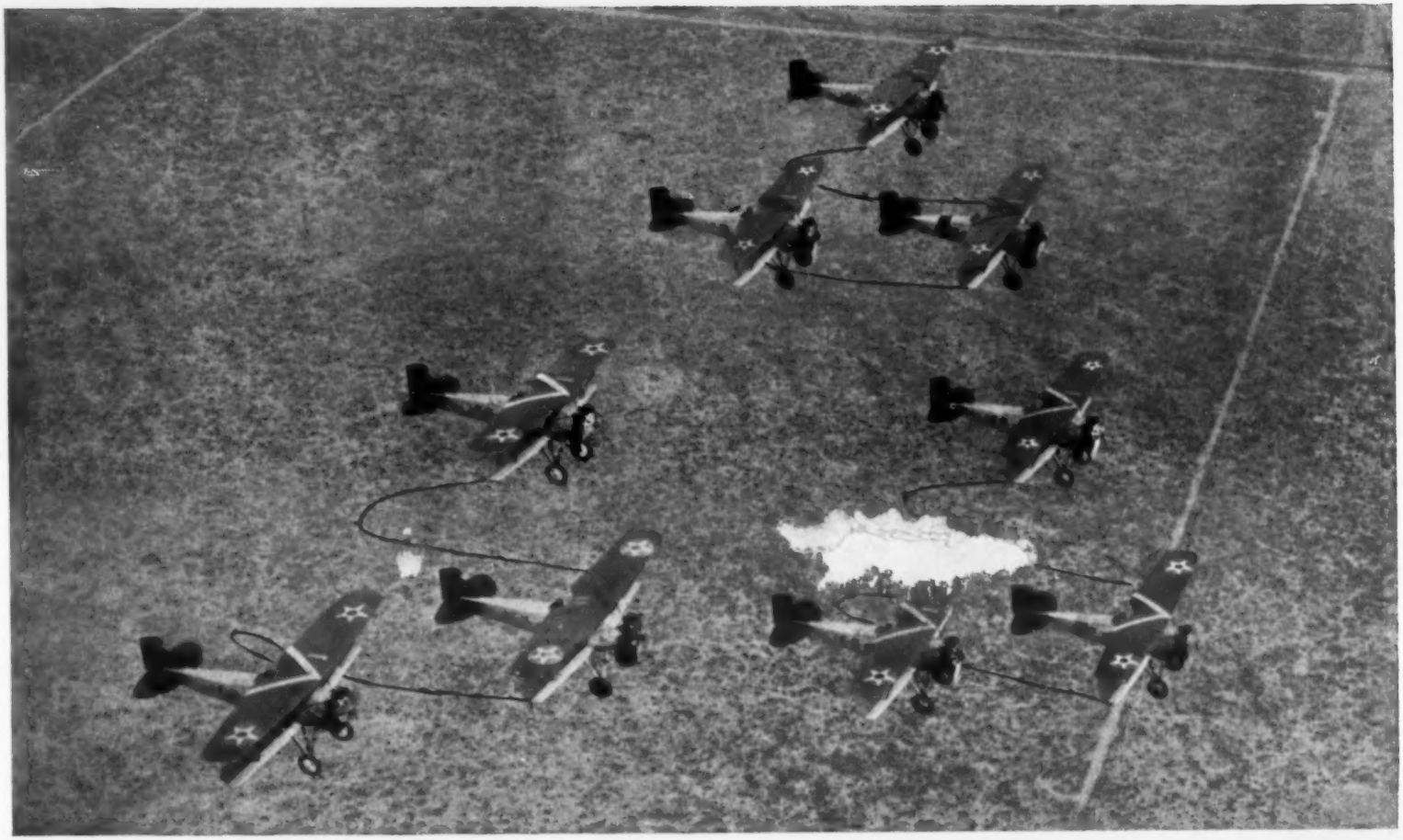
SOME OF THE SIXTY-NINE HORNET PLANES ATTACKING THE *Lexington*

They are lined up on the deck of the *Lexington*, ready to take off. These planes are sent off at ten-second intervals and during the three-hour demonstrations made attacks on the *Lexington* from the air.

Courtesy Bureau of Aëronautics, Navy Department

AIRPLANE HOOKED ON LANDING DEVICE OF THE U.S.S. *LOS ANGELES*

(See page 730.)



Courtesy Lieutenant L. E. Gebres, U. S. Navy

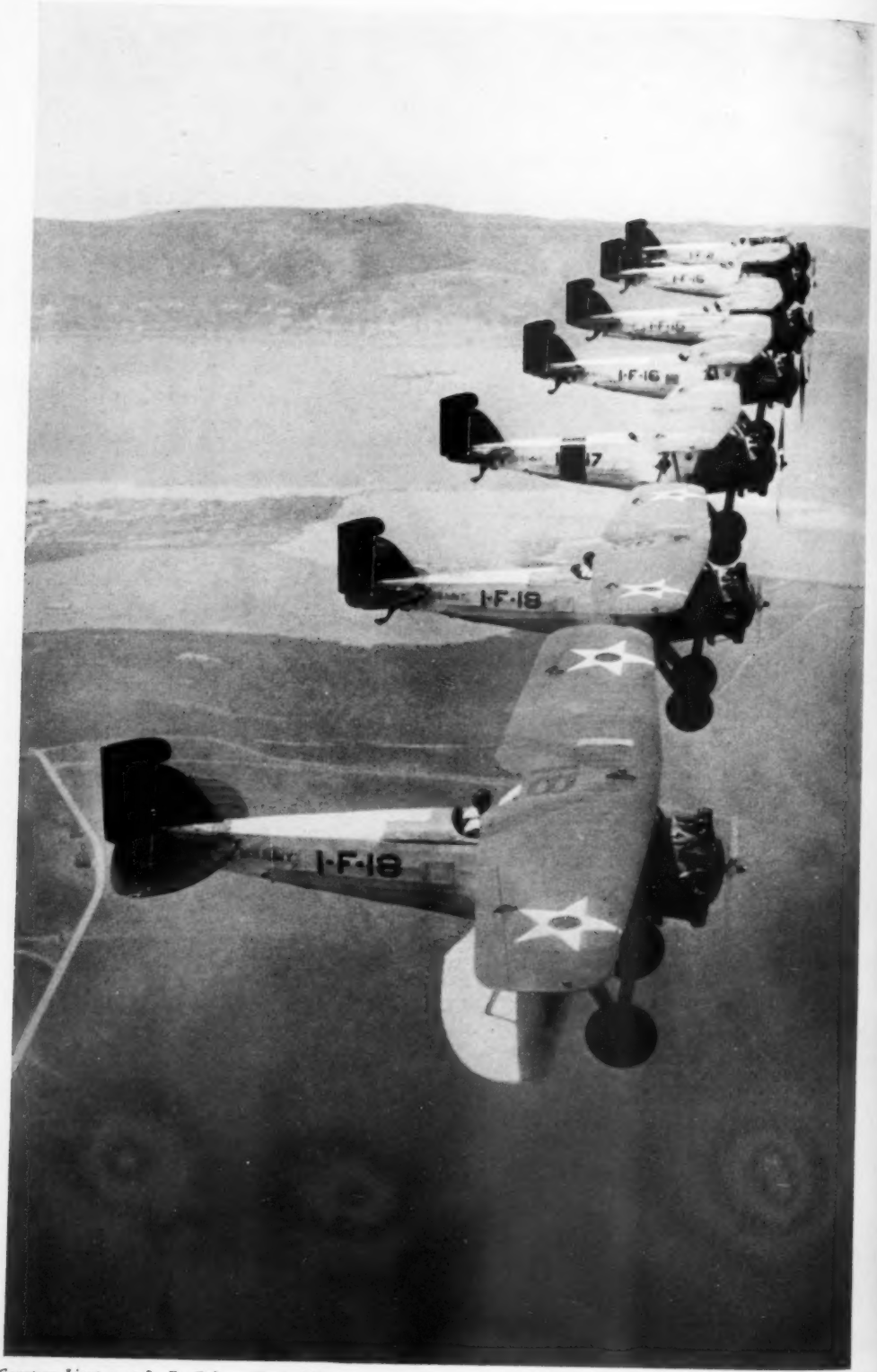
THE NINE "HIGH HATS" OF VF-1B IN VEE-OF-VEES FORMATION

They are lashed together with forty-foot lengths of manila line. The formation has just taken off. (See page 728)

THE NINE "HIGH HATS" OF VF-1B IN VEE-OF-VEES FORMATION
They are lashed together with forty-foot lengths of manila line. The formation has just taken off. (See page 728)

Courtesy Lieutenant L. E. Gebres, U. S. Navy

A SECTION OF THE NINE "HIGH HATS" OF VF-1B TIED TOGETHER



Courtesy Lieutenant L. E. Gebres, U. S. Navy

PLANES OF VF-1B FLYING IN LINE FORMATION
The wing tips are about five feet apart.

The Navy Cruises Inland

By LIEUTENANT L. E. GEHRES, *U. S. Navy*

THE Aircraft Squadrons, Battle Fleet, were represented at the 1929 National Air Races at Cleveland by Fighting Squadron One, the "High Hats," from the U.S.S. *Saratoga*. The flight of this squadron from San Diego to Cleveland and return over some 5,000 miles of country new and strange to all the pilots was a demonstration of the efficiency and mobility of the aërial arm of the Battle Fleet. The detachment, under the command of Lieutenant Commander Homer C. Wick, U. S. Navy, consisted of eighteen Boeing fighters, three Sikorsky amphibion transports with a personnel of twenty-one naval aviators, three aviation pilots, and nineteen mechanics. The squadron carried its baggage and light spare parts and was self-maintained throughout the flight.

From start to finish, the squadron logged 1,400 motor hours with only one forced landing due to motor trouble. The planes, loaded to full capacity with fuel and baggage, were landed in strange fields at altitudes as high as 7,200 feet above sea level with only one crack-up. Throughout the flight, the press and the public showed a most gratifying interest in the squadron and the naval aviation service. This was evidenced by the huge crowds which awaited our arrival at each scheduled stop and the mass of favorable publicity given the squadron in the newspapers of the cities visited. That large inland sections of the country have but slight knowledge of the Navy's aëronautical organization was demonstrated by the invariable first question: "If you fliers belong to the Navy, why do you have wheels on your planes?"

Not until August was it announced that VF-1 would make the flight and the scheduled date of departure was August 19. This allowed only two weeks to make the many preparations necessary to moving such a large number of planes en masse across the continent; and in addition, the regular employment schedule for this period was carried out. Refueling arrangements were particularly important as a delay of only five minutes per plane twice each day would result in a loss of two hours for the squadron.

Because the flight was to pass over sections of the country which seldom, if ever, have an opportunity to become acquainted with our naval air forces, it was necessary to make advance arrangements to insure a proper spread of information concerning the squadron's route, its personnel, and equipment. The planes and motors required careful checking over and a few planes needed a change of motors.

By Saturday, August 17, all preparations were complete, and a final review was flown for the Commander, Aircraft Squadrons. Early Sunday morning advance parties took off in two of the amphibions, one for Tucson, Arizona, and the other for Midland, Texas, to have all in readiness for an expeditious refueling at those points. The time of departure had been set for 6:00 A.M. Monday, but, due to a delay in the delivery of certain important mail (the expense funds), the start was not made until noon. The remaining transport was given a fifteen-minute start; and at twelve o'clock the eighteen fighters taxied from the line, took off in two nine-plane divisions, and four hours later landed at Tucson, Arizona, for the night.

By taking off at 4:30 A.M. and making exceptionally fast time in refueling at El Paso and Midland, Texas, the squadron caught up with the original schedule and arrived at Dallas 5:30 P.M., accomplishing a flight of 860 miles in eight hours in the air. The next day, a thirty-knot tail wind blew us out of Texas and across Oklahoma to the "Hat Box" Field at Muskogee in less than two hours. The favorable wind held and by one o'clock the squadron was on the

ground at Kansas City. During the night the wind shifted to the west and the following morning an average ground speed of 140 miles per hour was maintained to Scott Field, Belleville, Illinois, where the squadron refueled. From there to Fairfield Air Depot at Dayton was only a matter of three hours.

Leaving San Diego on the nineteenth and due at Cleveland at 2:00 P.M. on the twenty-fifth, we had allowed a two-day leeway for bad weather. Encountering nothing but the fairest of weather, we found ourselves in Dayton, only 190 miles from Cleveland, with two days to spare. This time was spent in scrubbing down the planes, checking motors, and removing the spare wheels and auxiliary gas tanks which were to be stored there until our return from the races. On Saturday morning the entire squadron took the air for formation drill, after which the nine "High Hats," a nine-plane acrobatic team, took off to rehearse their stunt program (see p. XXXVIII).

This consisted of taking off in a nine-plane vee-of-vees formation, closing the distance between planes to about fifteen feet as soon as the planes were off the ground. The group made one circuit of the field to gain altitude, then dove along the line of observers and pulled up to perform two successive nine-plane loops. A steeply banked turn was made at the end of the field and the formation returned along the line, the leader of each three-plane section flying upside down with the other planes of the sections closed in as usual. At the end of the field the leaders slow-rolled right side up. The formation did a tight reversement by sections and came back with all nine planes executing a slow roll in unison. On the next pass all nine planes slow-rolled on to their backs and crossed the field in this position, still retaining the vee-of-vees formation. Then the sections came up into a line of columns over the center of the field and went into a three-barreled "squirrel cage." In this maneuver each plane chases the one next ahead around a loop, the three planes in each section being equally spaced around the circle. On the third time over the top, each plane does an Immelman turn and dives into a loop, thus reversing the rotation of the squirrel cage. Three times over the top again, and the leaders straighten out and the vee of vees is rapidly reformed. This was followed by a standard three-way strafing attack on an imaginary target in front of the observers on the field. Rendezvousing quickly, the division circled the field and looped to a landing.

The next move was to break out six forty-foot lengths of light manila line and lash the planes of each section wing to wing. Thus fastened together, the division took off in the usual vee formation and made a number of passes over the field, shifting formation from vee of vees to echelon of vees to division echelon to line and to division vee. The show was ended by looping the nine planes in vee-of-vee formation still lashed together, after which the formation landed. Even the Army pilots watching us from the field admitted that it was a good show, and coming from them, we considered that praise indeed.

These acrobatics, though they may sound and appear spectacular and unnecessarily hazardous, are really only a combination of maneuvers which are used almost daily in the regular training of fighting plane pilots. That they are not dangerous for a competent combat pilot was proved on one occasion when a section leader's motor cut out while the entire formation was in inverted flight. This pilot, followed by the two planes of his section, righted his plane and all three spiraled down to a formation landing in the center of the field.

Sunday morning, the squadron moved up to Lorain on the shores of Lake Erie, about fifteen miles from Cleveland. There we were to be met by the Assistant Secretary of the Navy for aëronautics, Mr. David Ingalls, and the Chief of the Bureau of Aëronautics, Rear Admiral Moffett, whom the squadron was to escort into Cleveland. It was in landing at Lorain that the only crack-up of the flight occurred. A short, rough field, no wind, and a pilot attempting to land a little too short resulted in wash-out for the plane and a broken jaw for the flyer.

While the mechanics from the amphibions, which tucked up their wheels and landed in the lake, were removing the wreck from the field, three planes carrying the Assistant Secretary and his party landed. At 1:15 P.M. the squadron, now minus one plane and headed by Mr. Ingalls' group, took off and proceeded out over Lake Erie and along the shore toward Cleveland. This was probably the first time that a Navy fighting

plane squadron had ever maneuvered over any of the Great Lakes. Although it was fresh water and our squadron took pride in being accredited shellbacks, it looked like the sea and we felt quite at home.

At 1:59 P.M., the formation was in position 4,000 feet over the eastern end of the Cleveland airport and started a dive to pass low in front of the crowded stands. This was our big moment for which we had flown 2,500 miles. Exactly at two o'clock, our scheduled time of arrival, the squadron passed in front of the grand stands where 70,000 people were massed along the side of the field. Pulling up in steep climbing turn, the squadron put on a show of wing-and-tail formations while the Navy announcer, Lieutenant Chourre, explained our maneuvers to the spectators. After twenty minutes, the squadron landed, and, through billowing clouds of dust, found its way to the Navy area.

While the stunting division was standing by to take the air again at 4:20 P.M., the commanding officer returned from a conference with Mr. Ingalls and we were informed that it had been decided that there would be no formation acrobatics by the service units at the air races. The squadron was rather disappointed, but orders were orders, and we taxied out at four o'clock determined to at least show the crowd some of the most precise formation flying and maneuvering that they had ever witnessed. The two divisions performed cross-over turns and reversements from various formations, and much to our surprise learned, when we landed, that the crowded stands had been as thrilled by these maneuvers as we had hoped they would be by our acrobatics. Cross-over turns and reversements, which are simply expeditious means of turning a large formation in the air, were considered by the spectators as complicated evolutions fraught with the danger of certain collisions only narrowly avoided. This exhibition seemed to please the ever-changing crowd so much that it was repeated daily throughout the race meet.

The next day Colonel Lindbergh arrived at the field and, unannounced, walked into the Navy headquarters. The field directors soon learned of his presence and he was whisked up to the announcing stand to be introduced to the multitude. He returned an hour later in company with Mr. Ingalls and our commanding officer. After a short consultation the Colonel departed, and on the following day a wildly enthusiastic throng was electrified by the announcement that "Colonel Charles A. Lindbergh is now taxiing down the field and is about to take the air leading a section of the Navy 'High Hats.'" The preceding evening the commanding officer and the writer's section, Lieutenants Kivette and O'Bierne, had met Colonel Lindbergh at a secluded landing field in the vicinity of Cleveland and there we had demonstrated to him our particular technique in formation stunting. Then he led those two delighted young naval aviators into the air for practice. His very real ability as a combat and stunt pilot was amply demonstrated by the facility with which he took an unfamiliar plane and, after a remarkably short time for practice, flew and stunted it with a smooth sureness of hand that many pilots never attain. From then until the close of the races Colonel Lindbergh, leading this section of Navy planes, put on a daily exhibition of formation stunting which was easily the leading attraction of the race meet.

Wednesday afternoon the nine "High Hats" showed Cleveland "the rope stunt" for the first time. Since our final review at San Diego this had taken the fancy of the news writers and had been given prominence in all the accounts of the squadron's activities since we had left the coast. But there were those who doubted that we had ever really done it. To confound these skeptics, the ropes were shortened to thirty feet and the planes lashed together in sight of the spectators. Taking off in a cross wind the division went through all the scheduled maneuvers and landed with only one rope parted; (this happening when a plane hit a rut on taking off). Only once did the nine "High Hats" have an opportunity to display their full program of formation acrobatics. This was at Columbus where the division gave an exhibition on Governor's day at the Ohio State Fair.

Friday the Navy pursuit race was run off. There was some surprise manifested at the slow time, 127 m.p.h., made by the winner of this event, especially as some of the planes made single laps in time varying from 140 to 160 m.p.h. The "race" was really conducted as a spectacle rather than as a speed test. Our motors had brought us all the

way from San Diego and we were depending on them not only to take us back but to carry us through a strenuous schedule of gunnery exercises after we returned. For these reasons it was considered of prime importance to conserve our motors rather than subject them to the grueling strain of a full-out, 100-mile race. It was an exciting race to watch, nevertheless. Fifteen planes entered and they were always well bunched at the home pylon where the pilots opened them up and fought for places on the turn. The crowd received their money's worth of thrills and we saved our motors for more important work.

The Navy was also represented at the races by the new all-metal dirigible which was promptly nicknamed "the tin balloon." The *Los Angeles* sailed (see pp. XXXVII and XLII) over the field and demonstrated something really new when a plane took off from the ground with a passenger, hooked on to the dirigible, transferred the passenger, and brought another back to the earth. After accomplishing this feat the *Los Angeles* was moored to her mooring mast especially erected for her, stayed overnight, and departed for Lakehurst the following morning.

On Tuesday, September 4, the squadron started the return flight to San Diego. Leaving Cleveland in fair weather and proceeding to Chicago, then to St. Louis, and on towards Kansas City, the squadron encountered a violent storm which forced it to the ground at Jefferson City, Missouri. There again the value of our amphibions was demonstrated when the pilots, being unable to find the small river-bottom field in the heavy rain, rolled up their wheels and landed in the Missouri River.

In the face of low hanging clouds and driving rain the planes took off for Denver early the following morning, stopping at Kansas City and Goodland, Kansas, for gas. For many days our arrival in Denver had been widely advertised and the Governor of Colorado had declared the day a state holiday in honor of naval aviation. We, therefore, felt it incumbent on us to make every effort to arrive in Denver on time. But between Goodland and Denver, just as the planes were entering the foothills of the Rocky Mountains, a terriffic electrical storm was encountered which forced the squadron to abandon its course and seek safety on the ground. The first division made its way to Colorado Springs, while the second division, a half hour behind, went down in various small fields along the route. Next morning the squadron was rendezvoused at Colorado Springs and, with the able guidance of a local pilot, finally made its way through the fog-enveloped, mountainous country between Colorado Springs and Denver, arriving late in the afternoon in a pouring rain. Rain, snow, and low-lying clouds held the squadron on the ground in Denver for four days. As soon as the weather cleared the long-awaited and enthusiastically advertised aërial show was put on for the hospitable citizens of Denver and the convention of the United Veterans of the Spanish War.

Leaving Denver in the gathering dusk the squadron proceeded to Cheyenne, where an overnight stop was made. It was decided to make the flight from Cheyenne to San Diego, a distance of 1,100 miles, the following day. At four o'clock in the morning, two hours before sunrise, pilots and mechanics were on the field attempting to start the cold motors. The ground was frozen solid and during the night ice had formed on the wings and tail surfaces of the planes. After much hard cranking the motors were finally started and warmed up, and the planes took off and headed for the snow-covered Laramie Mountains just at sunup. Three and one-half hours later, the formation had crossed the high barren plateaus and the lofty snow-capped peaks which lie between Cheyenne and Salt Lake City. From Salt Lake City, the flight went south to Las Vegas, Nevada, over the mountains and desert country of southern Utah. Leaving Las Vegas the planes made good time to Oceanside just north of San Diego, where the squadron was ordered to rendezvous. Despite the length of the flight and the extremely hazardous nature of the country, the squadron arrived at the field in Oceanside within twenty minutes of the scheduled time, with the exception of one plane which had been forced by failing oil pressure to land at Palmdale in the Mojave Desert.

Taking off from Oceanside the planes closed up in wing-and-tail formation and headed for North Island. About five o'clock they dove down to pass the home hangar, broke formation, and landed. The Battle Fleet's first and most extensive inland cruise was finished.

An Elementary Description *of the* "Water-Recovery" Method *of* Obtaining Ballast *for an* Airship

By LIEUTENANT COMMANDER J. C. ARNOLD, *U. S. Navy*

A SUBMARINE running submerged must maintain equilibrium, or approximately so, for efficient operation and control. While running submerged a submarine does not burn a quantity of fuel but uses the energy stored in its electric storage batteries for propulsion. Hence, only minor adjustments of ballast are necessary. However, when the submarine has emerged it burns fuel not only for surface propulsion but also for recharging its electric storage batteries. In order to retain diving trim, ballast (water) is admitted to its tanks to compensate for the weight of fuel burned, lubricating oil consumed, refuse thrown over the side, etc.

An airship before taking off, weighs off just as a submarine does when making a stationary dive. But once in the air the main engines of an airship are used for propulsion and fuel is consumed. To date gasoline is the fuel principally used by all airships and the only fuel used by our one rigid airship, the *Los Angeles*. Just as a submarine must maintain equilibrium while submerged for efficient operation and control, so must an airship while under way. As gasoline is used, if no compensation is made, an airship will become lighter and lighter. For a while, by keeping it pointed down by the head, a constant altitude (analogous to depth for a submarine) can be maintained, but at a loss of speed and an increase of fuel consumption. And finally it becomes imperative to make adjustments of the trim in order to have any control whatever.

The simplest method to adjust for the loss of weight (fuel consumed) is to release sufficient of the lifting gas to the atmosphere. Using round figures, 1 gal. of gasoline weighs 6 lbs. and 1,000 cu. ft. of helium will lift 60 lbs. or 10 gal. of gasoline. Hence, if 1,000 gal. (6,000 lbs.) of gasoline is burned it will be necessary, in order to compensate for this loss of weight, to valve 100,000 cu. ft. of helium. When once valved helium cannot be recovered. And with the scarcity and the present cost of helium such losses are prohibitive during extensive operations. Furthermore, helium is obtainable only in certain localities and must be shipped and stored at the airship bases.

Hydrogen is relatively inexpensive and can be easily produced anywhere, where there is a small supply of ferrosilicon and caustic soda. Hence it is not of particular moment whether hydrogen is valved to the atmosphere or not. This could best be explained by a hypothetical case. Consider the *Los Angeles* inflated with helium preparing for a cruise out 2,000 miles, fuel, and return. On the way out, fuel, 24,000 lbs. by weight, was consumed. If compensation was made by valving helium, 400,000 cu. ft. of helium was valved. It would therefore be necessary to have an equal amount of helium on hand to take into the gas cells of the ship if she were to take fuel in order to start her return flight with as much gasoline as she put out with. A volume of 400,000 cu. ft. of helium would involve 2,500 cylinder containers weighing 150 tons, or four carloads.

If the *Los Angeles* had been inflated with hydrogen for the same cruise, caustic soda and ferrosilicon totaling only twenty tons, less than a carload, would have been required to give her the amount of hydrogen

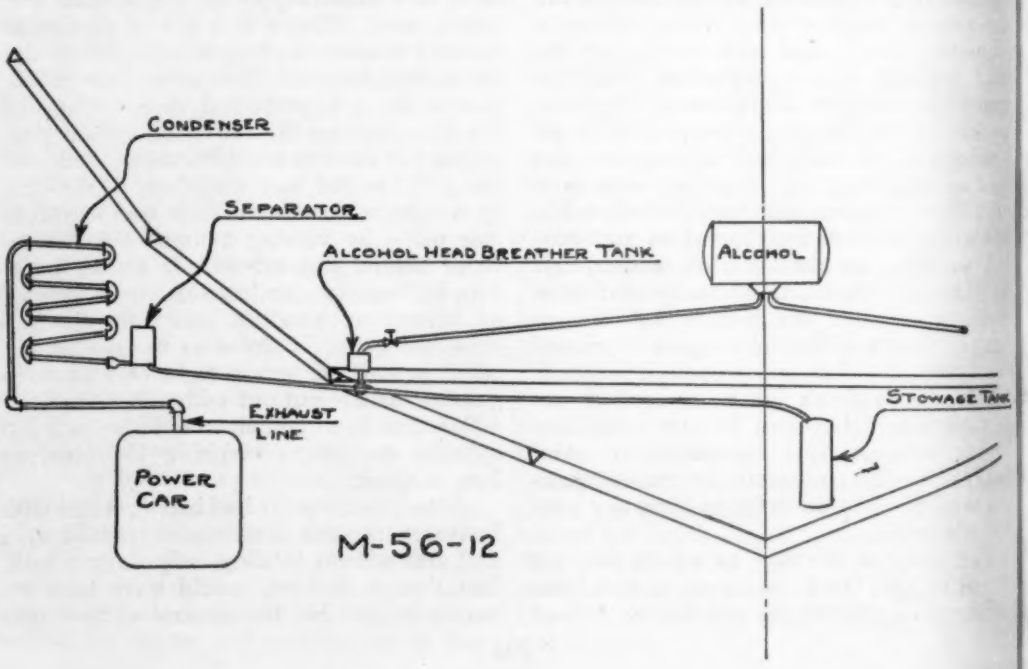
she had valved and no compression into transporting cylinders would have been necessary.

The above has been offered to point out the imperative need of some method to provide ballast in lieu of the fuel consumed where helium is used as the lifting gas. ("Blau" gas or an equivalent will not be discussed because the safety obtained by the use of the inert helium would be offset by an inflammable fuel gas.) Hence the United States, the possessor of practically all the helium known in the world, developed "water recovery" to its present stage. Some experimenting had been done in Europe but the development of a practical "water recovery" was made in the United States.

If on some cold winter morning you will look at the exhaust pipe of your automobile immediately after starting up, you will see drops of water running from it. That water comes from the exhaust gases of your motor. If your exhaust pipe were coiled several times around your car and you began driving through the cold air a steady stream of water would run from the end of the coil—water amounting to as much as the gasoline running to your carburetor. That is "water recovery" as adapted to the motors of an airship.

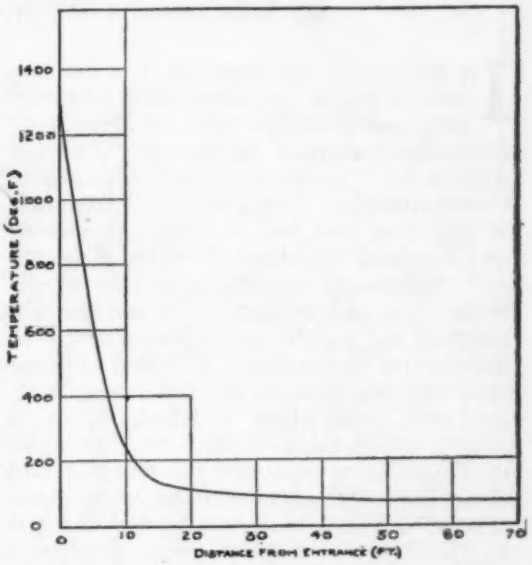
If you burn 100 lbs. of gasoline you burn a mixture of 1,600 lbs., as 15 lbs. of air are required to burn 1 lb. of gasoline. The 1,500 lbs. of air will provide 350 lbs. of oxygen and, with average weather conditions, 10 lbs. of water vapor. The 100 lbs. of gasoline will provide the 15 lbs. of hydrogen. Two particles of hydrogen will combine with one particle of oxygen. The unit weight of hydrogen is 1 and that of oxygen 16; so the two particles of hydrogen weighing 2 plus the one of oxygen weighing 16 have formed a particle of water weighing 18; the water formed therefore equals 9 times the weight of the hydrogen available, or 9×15 (weight of hydrogen) = 135 lbs. Adding 10 lbs. for the water vapor originally in the mixture gives a result of 145 lbs. Therefore, after combustion there will be in your exhaust pipe 145 lbs. of H_2O which can be collected if condensed. It is not necessary in an airship to continue the cooling to condense the entire amount but it is endeavored under average conditions to condense sufficient to produce water in amount equal to the weight of fuel consumed, thereby keeping the ship in continual equilibrium.

A general description of the arrangement of the water-recovery apparatus installed on the *Los Angeles* should make a few points clearer. The exhaust gases in two exhaust pipes from the engines' two exhaust mani-



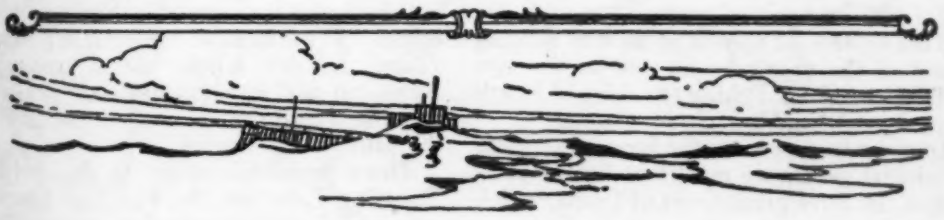
folds are led up through the top of the engine car and join into a common riser. Here is connected an atmospheric exhaust controlled by a valve in order that the condenser may be cut out. The riser, made of steel, is well finned and leads to the upper condenser header. By the time the gases reach the condenser the temperature is reduced to about 900°F. which is a safe temperature for aluminum. The gases then pass through the tubes of the condenser. There are ten rows of tubes, 45 tubes in each row. The tubes are 1 in. in diameter and 5 ft. long, the metal being .02 inches thick. The tubes at each end are pressed into headers made of cast aluminum which serve to change the direction of the exhaust approximately 180° every five feet. After passing through the lower row of tubes the gases, holding water in suspension, pass upward and through a baffled separator which gathers the water which then flows by gravity to a stowage tank within the ship while the gases pass to the atmosphere. Another drain is connected to the low point of the lower header to allow free water present to run off. This drain joins the lead from the separator. To prevent freezing of the water in cold weather, alcohol is introduced into the water lines. The flow of alcohol is controlled according to the temperature. It is also necessary to partially screen the condenser with cloth in very cold weather.

The temperature within the exhaust manifold at the engine is about 1,600°F. It has been stated that the temperature of the gases when entering the condenser is about 900°F. or a drop of 700°F. in ten feet of travel. It is interesting to note then that fifty more feet of travel are required to reduce the temperature from 800°F. to about 95°F., at which temperature the water obtained will equal in weight the fuel consumed. The curve submitted clearly shows the drop in temperature according to the distance the exhaust travels. This curve is not exact for the apparatus on the *Los Angeles* but it is a typical curve. At the lower temperatures the specific heat of the gases is many times greater than at the higher tem-



peratures, caused by the latent heat of condensation, and the difference between the gas temperature and the air temperature reduces progressively as the gas temperatures drop.

Although the water recovery as at present developed will make water, it is not entirely satisfactory. Not only is the weight considerable, but the air resistance is high. Consequently speed is reduced, fuel consumption increased, and the cruising radius reduced accordingly. It is hoped and expected that improvements will be made in the not so very distant future.



Chinese Provincial Names

By LIEUTENANT W. A. P. MARTIN, *U. S. Navy*

IN EUROPE and America it is the custom to name the towns and countries after some hero or race, or after some distinctive feature of the terrain. We have Athens for a goddess; Rome, Alexandria, Constantinople, Petrograd or Leningrad, Washington, and San Francisco, for men; and England, Scotland, France, Belgium, and Normandy for the race that dwells there. As for Ireland it is not certain whether the people named the country or the country the people. A friend of mine once told me that on the old maps, Scotland was Scotia Minor and Ireland, Scotia Major. Paris takes its name from the tribe of Parisii, who inhabited the region round about Lutece, the ancient name of the town where Paris now is. London owes its name to features of the countryside, to *llyn*, a pond, and *dinas*, a hill.

In China, however, where men count for little and women for less (until they are grandmothers), towns and provinces derive their names from their location relative to a great river or lake, or to a chain of mountains, or to the sea.

In China also the manner of describing one location in respect to another is peculiar. Our words "left," "right," "in front of," and "behind" are often replaced by the cardinal directions: north—*pe*, south—*nan*, east—*tung*, and west—*si*. When pointing out an object in a room, for instance, we should say that it is in front of, or to the right of the table; the Chinese says that it is to the north of the table or against the east wall.

This system of speech is used in naming many of the provinces as well as the two well-known cities, Peking *(be djing)*,[1] North Capital, and Nanking, South Capital.

In order to appreciate the force of Chinese provincial names we must first fix the position of the three great rivers of China, which are from north to south, the Hwang Ho, the Yangtze Kiang, and the Si Kiang, of several ranges of mountains, and of one important lake.

The Hwang Ho, or Yellow River, which now empties into the Gulf of Pechili, some distance to the west of Chefoo, less than a century ago flowed into the Hwang Hai, or Yellow Sea, at what is now twelve hours' steaming distance to the northward of the mouth of the Yangtze Kiang.

The Yangtze Kiang (Blue River), or *Yahngzee Djang*, as it is pronounced, the greatest of the rivers of China, flows through the heart of China from Tibet to the Yellow Sea. In the south there is the Si Kiang or West River, which is important as a navigable stream. Though it forms the boundaries of no territories, it affords an excellent means of communication for pirates and others between the sea and the provinces of Kwangtung and Kwangsi. It flows parallel to the northern boundary of Tonkin, French Indo-China, and finally empties between Macao on the south, and Hong Kong, a lofty island to the northeast.

Canton is situated above the mouth of the Si Kiang as is Shanghai near the mouth of the Yangtze—about sixty miles from the sea. It is the capital of Kwangtung, of which the word Canton is a corrupt pronunciation.

About eight hundred miles up the Yangtze, a hundred miles above Hankow and Wuchang, there is a great lake called Tungting which connects with the Yangtze to the north. At the head of this lake is Changsha (Long Sands) where there are usually American and foreign gunboats present to exercise a quieting influence in the town and the province of Hunan.

Three hundred miles to the north of Tungting Lake are the Fui Nui Shan (or mountains) which extend in a general east and west direction south of Shansi. Im-

[1] In Kubla Khan's time Tartar influence named Peking Cambulac or City of the Great Khan.

MANCHURIA
VLADIVOSTOK
CHOSEN
PORT ARTHUR
CHEFOO
HWANG HAI
TUNG HAI
PE
SI — TUNG
NAN
TAI WAN
SHANTUNG
KIANG SU
SHANGHAI
CHEKIANG
FUKIEN
NANKING
ANH WEI
PEKING
CHIHLI or PECHILI
HONAN
HANKOW
LAKE TUNGTING
HUPEI
KIANGSI
SHANSI
HWANG HO
TUNG KWAN
SHENSI
HUNAN
KWEICHOW
KWANGTUNG
CANTON
HONGKONG
NAN HAI
MONGOLIA
KANSU
SZECHWAN
YANGTZE KIANG
YUNNAN
KWANGSI

mediately to the west of this range is another, the Tsing Ling Shan. Between the two is the very important Tungkwan Pass which affords passage from Central China into the north, to Mongolia and beyond.

In the western part of Shantung is the Tai Shan or Great Mountain range, which runs north and south. Tai Shan is sacred as the birthplace and final resting place of Kung Fu Tze or Confucius.

Armed with the foregoing bits of information, the Chinese puzzle easily resolves itself. In the old days of the empire the territory south of the Yangtze used to be called Kiang Nan or "South of the River." This territory extended from the sea westward to Tungting Lake. Being of unwieldy size it was split up into two provinces: Tche Kiang Nan or "On the Coast South of the River" and Kiang Nan Si, or "South of the River West." The *Nan* having been dropped, we have the present provincial names Chekiang and Kiangsi. The latter province is bounded on the west by Hunan, or "South of the Lake," *hu*, the word for lake, referring to Tungting Lake.

To the north of this lake and extending along the north bank of the Yangtze is the province of Hupeh or "North of the Lake," in which province Hankow is situated. North of Hupeh but south of the Hwang Ho is Honan, "South of the Ho," *ho* being another name for river. Still to the north of Honan is the province of Shansi or "West of the Mountains," the mountains being probably the sacred Tai Shan. To the northeast of Honan and jutting out into the sea toward Chosen or Korea is Shantung or "East of the Mountain," east of the Tai Shan. On the north coast of Shantung are Weihaiwei and Chefoo where the British and American Asiatic fleets base in the summer, the latter at Chefoo.

Between Shantung and Honan and to the northward is the province of Chihli or "Direct Rule," sometimes called Pechili or "North Direct Rule." Peking is in this province, the capital of most of the emperors, whence the name Pechili.

Returning to the middle west, we have to the west of Shansi the province of Shensi whose name in Chinese means "West of the Pass," the pass in question being that of Tungkwan above mentioned. It may be interesting to note that Shensi is pronounced like Shansi by the Chinese but with a different tone. It is only spelled differently in Latin characters to make a distinction for Europeans. To the south of Shensi lies Szechwan, the largest province in China and the richest in grains and minerals of all the eighteen provinces. It takes its name from *sze*, four, and *chwan*, river. The four rivers are the tributaries of the great Yangtze Kiang which rises in the Tibetan highlands.

The three southernmost provinces from the sea westward are Kwangtung or "The Broad East," in which is Canton; Kwangsi, "The Broad West;" and Yunnan or "The Cloudy South."

Of the remaining five provinces of the eighteen, three have names compounded from principal cities or prefectures. Of these, Kiangsu (in which are Shanghai and Nanking) was named for Kiangning, the ancient name of Nanking, and for Suchow. West of Kiangsu is Anhwei, which lies both north and south of the Yangtze, between Honan and Kiangsu. It was named for its chief prefectures. Kansu, in the extreme northwestern part of China extending toward eastern Turkestan, was named for the cities Kanchow and another Suchow.

Kweichow or "The Precious District" is the high-sounding name of the province in western China, between Szechwan and Kwangsi, on the northwest and southeast, respectively, and Yunnan and Hunan on the west and east. It is one of the most mountainous and unproductive parts of China. Perhaps this name was given as the Greeks named the Furies "the Gracious Ones" and the Black Sea the "Hospitable Sea," for the sake of propitiating the evil spirits which are rife in the land.

The last of the eighteen provinces has the best name—Fukien or "The Happy Establishment." This province lies on the coast between Chekiang and Kwangtung. In it are the ports of Amoy and Foochow.

We have seen that bodies of water and mountains, both of which have a close relationship to *feng-shui*, or "wind and water" (which are at the base of the Taoist geomantic superstitions) have largely determined the choice of the names of the provinces of the old Celestial Empire. Of western hero worship as manifest in the nomenclature of towns and countries of Europe and America, there is none. In China it is the sage, not the warrior, who is honored—and not the man but the principle.

The Navy *and the* Merchant Service *in* Behalf *of* Amity

By LIEUTENANT HANSON W. BALDWIN, *U. S. Naval Reserve*

LONG ago, when the word "navigation" had not yet been born and the world was still a pleasing puzzle, the earth's first naval officer took command of a group of armored soldiers crowded in the open hull of an oar-propelled galley, and ventured on the waters in the world's first warship.

A century or more, perhaps, before this unknown admiral created the beginnings of naval power, tiny galleys, rowed swiftly by half-naked crews, stole from headland to headland, skirting the shores of mysterious oceans and flirting with unknown dangers for the sake of the cargoes they carried; "ivory and apes and peacocks," sandalwood and spices and all the opulent offerings of a bountiful world whose natural yield was yet untaxed by the greedy hand of man.

"As it was in the beginning, is now and ever shall be." Economic laws have forever decreed that naval sea power shall be antedated by commercial sea power, that the former is conceived, born, and nourished through the growth of the latter, that navies exist primarily because of sea-borne commerce and that commerce can exist and grow because of navies.

In spite of this interrelation of two ancient maritime institutions, a lack of cohesion and coördination between the services and even feelings of misunderstanding and jealousy have been the rule rather than the exception. Such feelings have probably existed since the days when our thirteen Colonies first banded together to form a nation. They were accentuated with the disappearance of the privateer and reached a head with the advent of modern warfare, when the convoy system first placed large numbers of merchant vessels under the direct command of naval officers. They have continued in both post-war Navy and merchant fleet, to the detriment of the combined mission of both, the furtherance of America's sea power. These misunderstandings are, fortunately, not momentous; they are but petty irritations or jealousies born of trivial incidents, rivalries where there should be but harmony.

It should be a cause for chagrin to both services should such conditions continue to exist now that both America's Navy and her merchant fleet are occupying positions close to world primacy. The frank airing of differences and the admission of faults are the only remedies. This article is intended as the precursor of what it is hoped will develop into a frank discussion between the two services that will lead to better mutual understanding.

In the Navy, particularly among the younger officers like myself, I have noticed that whenever the merchant marine is thought of at all there goes with the thought an air of tolerant superiority. Because of the advantage of a Naval Academy education and the social position which graduation insures, many officers seem to feel that the officers and crews of merchantmen are inferior creatures, and that the only seagoing ship worthy of note is a man-of-war. Because they have had the advantages of a good education and can handle the intricacies of the English tongue with more correctness, many youthful officers and some mature ones look down upon the officers and men of the merchant service, not only socially and mentally, but professionally.

Such an attitude does discredit to the officers who adopt it. In this day of the fast-turning printing press, many of the men who bring our cargoes from the Orient and the West are self-educated; a few of them to a greater extent than the narrow, pro-

fessional training of the naval officer permits. In this day of the palatial passenger liner, many a master mariner and chief officer is more adept, from long practice with gushing passengers, at small talk and social niceties than the most accomplished gallant who ever signed the hop liberty list in the rotunda of Bancroft Hall. But all this is beside the point. In the teeth of a North Sea gale or in the grip of an Adriatic bora or Indian monsoon, the mastery of the sea goes not to him who knows the art of sipping tea, nor to him who can best describe the details of the Battle of Marathon.

In proportion to numbers, the merchant marine can probably offer considerably more skilled navigators than can the Navy. This is primarily due to the fact that in the merchant service all licensed deck-watch officers must be navigators; i.e., the officer of the deck is required to do a share of the "day's work" which is ordinarily done in the Navy in its entirety by the navigator alone. Thus during all his career at sea, the deck officer in the merchant service actually navigates his ship, whereas in the Navy an officer may be assigned to navigation duty only once or twice in his professional career. There may be, and usually are, long intervals in the naval officer's life when he does not even take a sight.

In seamanship, the Navy is probably slightly superior, although many officers of the merchant marine will question such a statement. It is undoubtedly true that the "old timers" in our merchant fleet are far more skilled in the intricate art of ship handling than is the average naval officer. But the younger officer in the merchant marine, due to the changing customs of the sea, and the amount of "red tape" attending the departure or arrival of ships in port, is given very little chance to learn practical ship handling unless he serves under an exceptional "skipper" and on the ships of an unusual line. On the other hand, the Navy, with its maneuvers in formation and its frequent seamanship exercises, gradually develops officers who are skilled in ship handling.

Lines of professional demarcation could be drawn *ad infinitum* with arguments to show that the weakness of the one service may be the strength of the other.

But perhaps the results desired in this article can be obtained more quickly by describing briefly life and methods aboard a typical merchantman, a 21,000-ton passenger-freighter engaged in the South American trade, aboard which I recently shipped as a quartermaster. The trip proved a revelation to me, and I believe that similar knowledge of the conditions confronting officers in the merchant marine and a better understanding of the lives they lead would go far toward promoting more amicable relations between the naval and the commercial servers of the sea.

Living my life as a quartermaster, I went back to my midshipman days: scrubbing in a bucket, eating "chow" from a linoleum-covered mess table while seated on wooden benches, scrubbing paintwork or "soogeying" as it is called in the merchant service, "caulking off" on a hatch cover, and in general following the hard but somehow alluring life of a seaman. One old companion of "Crab Fleet" days was missing; for the hammock a narrow iron bunk was substituted which was well populated with other creatures besides myself.

I soon found that running ships with all of Uncle Sam's resources back of you is a far different thing from running ships backed by private capital; that naval ships are cleaner than vessels of the merchant fleet; that the men of the merchant service do far more actual physical work in a shorter time than do the men of the Navy, but do not do it as thoroughly; that discipline in a merchantman is very lax compared with discipline on a man-of-war; that less attention is paid to the crew's welfare in the merchant service; that pride in the ship which is so much a part and parcel of naval life is to a great extent lacking in the merchant service; that merchantmen spend far more of their time at sea and consequently their officers and men are engaged far more in strictly professional duties than is the case with naval personnel; and that therefore the knowledge of the merchant marine is knowledge practically acquired, whereas the knowledge of the Navy is knowledge more or less theoretically acquired from books.

The upper decks of this 21,000-ton ship, the crew's quarters, and various other compartments, were cared for by the three quartermasters (who also stood a watch in three on the bridge), who cleaned the bridge, the flying bridge, and other miscella-

neous places, and by the boatswain and his mate and fourteen sailors, "A.B.'s" and "ordinaries." Aboard a naval vessel similar cleaning spaces would have been assigned to at least a hundred men. The entire crew, including the steward's department, numbered less than three hundred men. A naval vessel of similar size would be manned by a crew of approximately one thousand. The crew of a merchantman is limited in size not only because of lack of space for accommodations due to great cargo holds and passenger staterooms, but also because of economy.

In this connection, the penurious policy of many ship owners, who force ships which are sadly in need of overhaul to run month after month without repair, is a serious blow to the morale of officers and crew, who are continually harassed by efforts to effect repairs which really require shore attention and the leisure of an overhaul period.

The chief mate acts as executive officer of the ship and upon his shoulders falls much of the burden that in the Navy would go to the captain. In addition, in some ships where there is no first mate, he stands a watch, always the four to eight, morning and evening. In vessels which have a first mate in addition to the chief mate, the latter does not stand any watches and devotes all of his time to executive duties. He is responsible for the work of the deck department and for all its equipment, and transmits his orders to the deck force through the boatswain. Coming into or going out of port, he takes his station forward in charge of the ground tackle and the forward mooring lines. In some vessels he is in general charge of the unloading or loading of cargo, with the second mate in active charge of the after holds and the third mate of the forward holds. It can be easily seen that a conscientious chief mate fully earns his rather meager pay.

The second mate always stands the afternoon watch and midwatch. He is in charge aft when coming into or leaving port. He is also generally charged with the care of the navigating equipment, although practice differs on various ships. The third mate stands the eight to twelve watch morning and night, and takes his station at the engine-room telegraph when getting under way.

At sea, the three watch officers' duties are limited entirely to watch standing, which includes the navigation of the ship during the course of their watch. When off watch they are free to follow their inclinations, except, of course, in emergencies. They work, therefore, eight hours out of the twenty-four, just as do the sailors and petty officers of the deck force. The third mate starts off the navigation day by taking a forenoon sun sight, which he follows up with a sight for noon latitude. The second mate sometimes helps to check the noon position and takes an afternoon sun sight, and the chief mate takes star sights, night and morning, when available. Many officers in the merchant service still use the old "Time Sight," although many now employ the Marcq Saint-Hilaire method. Any method which will yield a correct result is permissible. The results are always checked by the captain and are usually very accurate. Radiocompass bearings are used frequently and many of the officers of the merchant service are cognizant of each new "wrinkle" in the art of navigation.

The frequent watches do not give the officer in the merchant service much time or opportunity to exercise leadership or supervision over the men. In fact he rarely attempts to do so except in connection with those with whom he is thrown in contact on watch, for his duties do not call for it. Unlike the division officer in the Navy, who is responsible for a certain portion of the ship's cleanliness and upkeep and is given the leadership over a certain number of men with which to accomplish this result, the officer in the merchant marine is not generally responsible for the cleanliness or upkeep of the ship, unless he happens to be the chief mate, in which case he has the responsibility for the entire portion assigned to the deck force. Discipline and cleanliness suffer as a consequence. On the passenger-freighter, the crew spaces in general were fairly clean, but the heads and washrooms were filthy. The discipline was very lax; many of the crew were drunk, regardless of working hours, during much of their stay in port; a number of them were drunk at sea from smuggled liquor, and once or twice one or two of the petty officers were drunk on duty. This slackness in discipline, combined with the apparent lack of pride of the great majority of the crew in their ship

and the roving tendency of the average "A.B.," who jumps ship whenever he feels like it, are to my mind, the worst features of merchant marine life.

The passenger-freighter on which I served was actually steaming at sea about four and one-half weeks of the six weeks' time required to make the round trip from New York to Rio de Janeiro, Santos, Montevideo, and Buenos Aires. Other merchant vessels spend an even greater proportion of their time at sea. Practically all the officers who hold "tickets" or licenses have followed the sea as man and boy and have spent the largest part of their lives actually on the oceans, without the diverting, though professional, interludes of shore duty of the naval officer.

A few of the merchant officers of today have been made from junior officers, men usually from schoolships who have not had the necessary experience to become officers. These junior officers perform much the same duties as junior officers in the Navy, but they are without a license, and they are expected to learn navigation and other duties by experience. The great teacher of the merchant service is experience, and it beats its insistent lesson into even the dullest of heads.

The stowage of cargo, which in olden days used to be such an important item in the education of a merchant officer, is now becoming more and more the specialized function of stevedoring companies and longshoremen. Only the smaller ships, or ships which touch unfrequented ports, require their officers to give direct supervision to stowage and handling of the cargo.

In general the organization below decks of the "black gang" follows the lines of the deck organization. The chief engineer is in absolute charge of the propelling equipment and all its appurtenances. He has much more authority and latitude than is accorded to such a position in the Navy. He is in reality "skipper" below decks, although he is of course subject to the captain's orders. A number of watch officers and junior officers stand watches below decks just as do the deck officers.

The shortage of men is not as noticeable as in the deck force, but the quota is still below naval standards. The officer personnel both above and below decks is limited in numbers as compared to the Navy.

The engineering plants of many merchant ships, although not so modern as many of the Navy's prides, are efficient and well planned. The "black gang" in many vessels, however, is forced to struggle like the deck force to effect repairs while operating which should be made during an overhaul period. The close policies of many owners prevent maximum efficiency much of the time.

In summation: the merchant marine personnel is composed of officers and men who have made the sea their almost constant livelihood since early youth. Their knowledge is that unforgettable sort bred of long and often bitter experience, and for this reason is certainly equal in certain branches, if not superior, to that acquired from books by naval personnel. Their defects are due, not to inherent character weaknesses nor to lack of "book larnin'" but to handicaps forced upon them by penurious owners, or the conditions in which they serve.

To aid the Navy to a better understanding of its comrades in the merchant service, I indorse heartily the suggestions sponsored by Mr. O. H. M. McPherson, contained in his article, "The Navy's Relation to Commercial Shipping," in the March Proceedings. I suggest as a supplement to the proposed course, study of the organizations and methods of merchant vessels, the duties and responsibilities of the various officers and members of the crew and similar data, as outlined in the manual of the merchant service, *Men on Deck*, by Master Mariner Felix Riesenberg.

In conclusion let me stress once again the principal reasons for giving due respect and esteem to the merchant service and its personnel:

1. The Navy exists primarily because of the existence of the merchant service.

2. The officers of the merchant marine have lived their lives upon the seas; the ocean is their home more truly than in the case of the naval officer. Their professional qualifications and their ability as seamen, should not be misjudged nor sullied by the use of an occasional double negative or an incorrect grip upon a teacup.

3. Running a ship with the resources of a government behind the engines is far different from running a ship with the specter of a tight-fisted owner of limited resources stalking the bridge with the "old man."

The Metal-Clad Airship

By LIEUTENANT C. V. S. KNOX (*C.C.*), *U. S. Navy*[1]

THE conventional rigid airship has fabric-walled gas cells to hold the gas, cord nettings to restrain the gas cells, many wires and substantial longitudinals to give strength—as a beam has strength—and finally, an outer cover to give a streamline form and keep out the weather. Why not combine all these parts of the airship into a single piece of material, that is, a metal skin? Thus, weight would be saved, tedious wiring work would be saved, and weathering and replacement of the outer cover would be eliminated. Such was the reasoning of the engineers of the Aircraft Development Corporation of Detroit (now a subsidiary of the Detroit Aircraft Corporation) in designing the metal-clad airship, which was ultimately built under contract for the Navy as the airship *ZMC-2*.

At first glance the theoretical advantages of a metal-clad ship appeared tremendous, but many practical difficulties soon presented themselves. How could an all-metal airship envelope be made gas-tight? How could the seams be made? Would it be light enough to be practical? Since the metal would be a continuous rather than an intermittent structure, how could it be supported while building? If it could be built, how could the air be removed from the hull to introduce the lifting gas?

In working out these problems a definite design was finally evolved in a small airship, or blimp, of 200,000 cubic feet capacity; length, about 150 feet; and maximum diameter 50 feet. There was a metal skin about 0.01 inch thick, with five main frames inside of the metal skin to maintain the circular form and distribute the concentrated loads from the car, the handling lines, and the control surfaces; and there were twenty-four light longitudinals and a number of intermediate frames, chiefly for support during construction and in the hangar. So much for the hull. In addition, there were eight sets of fixed and movable surfaces to give stability and control, with an enclosed all-metal car fastened close to the bottom of the hull to carry the twin engines and the crew. Inside of the metal hull were two rubberized fabric bags, called ballonets, which by being filled with air under pressure would maintain pressure within the entire hull as necessary during flight.

After an especially thin gage of aluminum alloy sheet had been procured, the next problem was the development of seams. Hand-riveted seams were made and tested, and found to have satisfactory strength. Since even a ship as small as this would require several million rivets, it was an economic necessity to develop an automatic machine to make the seams. The automatic riveting machine, as finally designed and used, operated much like a noisy sewing machine—it "stitched" along at the rate of a foot a minute—joining two sheets of metal by three rows of rivets about the size of ordinary pins. No punching or drilling of the sheets was necessary. The rivet material in the form of three wires was fed into the machine, the wires punching their own holes before being headed up. The final step in making the seams was to paint the slightly opened edge with a sticky solution, which crept into the joint and made an effective gas-tight seal.

After much calculating, the "fat cigar" shape was reduced to a mathematical curve from which the coördinates of any points could be calculated. From these, "patterns" were developed in the form of curved strips running transversely around the envelope. The method of construction finally used was to build the ship in two halves, starting with a small ring at each end and hanging it from the hangar roof so that the axis of the ship was vertical and the construction work was done from the floor. The curved

[1] Navy Inspector during construction.

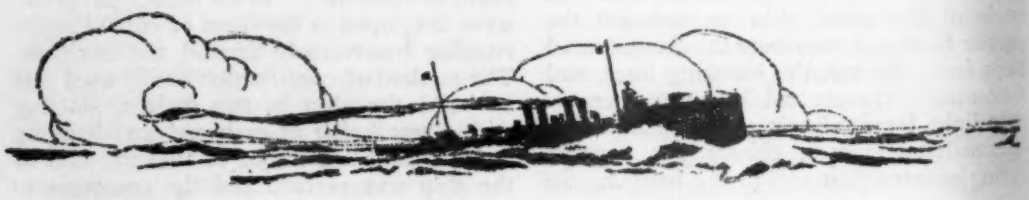
strips were first riveted end to end and wound on a spool to such a length as would encircle the ship once. This strip was unwound from the spool as it was riveted to the part of the ship previously built. After a complete strip was riveted, the entire assembly was hoisted a foot or two higher and the process repeated. As the section of the hull grew larger, the riveting machine was mounted on a circular track on the floor so as to travel completely around the ship. (See p. XLI.) Finally, the two halves of the ship were completed with the longitudinals and structural rings riveted inside of each half. Then the problem was to tip these halves up to a horizontal position and joint the flimsy edges together. Imagine trying to join two huge sections of stove pipe, each about seventy-five feet long and fifty feet in diameter and weighing hundreds of pounds! The two circumferences were exactly equal, but on account of the flimsy nature of the material when not under pressure, the two ends were out of round and the irregularity occurred in different parts of the circumferences. Finally, after much work, the halves were clamped exactly together and the closing seam riveted—with one man working inside and another man outside. Although apparently flimsy, the thin metal skin is very strong when the airship carries pressure. A man with soft shoes can walk on top of the hull, or inside on the bottom, without doing any damage. As many as seventeen men have entered the bottom manholes and been at work at one time inside, on the bottom of the ship.

The next problem was inflation. After the hull had been completed, a heavy gas (CO_2) was introduced into the bottom—blowing the lighter air out of the top. When the air was reduced to a negligible amount, the light lifting gas (helium) was introduced at the top—blowing out the heavy CO_2 from the bottom. As a final stage the CO_2 was removed from the mixture of helium by passing through an especially designed and built scrubbing apparatus. An amusing incident, although serious at the time, happened when the scrubber was first turned on. It was found that the scrubbing solution became so hot as to produce steam which would enter the airship, finally condensing into some unwanted water ballast. The difficulty was finally overcome by slowing down the scrubbing operation and placing a large number of ice cakes in the scrubbing solution.

Meanwhile, the car had been finished and attached and the engines tested out, so that the ship was ready for its first flight. After watching the construction work from the first two-foot ring to the completed airship, it was an inspiring sight when the ship was first moved from the hangar. The test pilot gave a few curt orders to the ground crew and the new airship floated out of the hangar and soon flew away from the field on its maiden flight.

After a number of trial trips to check various features of the design, the ship was flown to the Naval Air Station, Lakehurst, New Jersey, where it is being subjected to long time trials as an experimental unit.

As an engineering development, the construction of this ship has proved that a metal airship hull can be built at least in a small size; that it will hold gas remarkably well; and that with due precaution the necessary pressure for safe operation can be maintained. However, handling under all conditions of weather, effect of continued vibration on the strength of the metal and tightness of the seams, necessity for local repairs, and means of making such repairs—all these must be checked to determine the final worth of the present experiment and to indicate what further possibilities of future development are justified in this interesting new type of airship construction.



Courtesy Lieutenant C. V. S. Knox (C.C.), U. S. Navy

STERN HALF OF *ZMC-2* DURING CONSTRUCTION

This ship was built in two halves, starting with a small ring at each end and hanging it from the hangar roof with the axis of the ship vertical. Note riveting machine on circular track in lower left-hand corner. (See page 742)

Courtesy Aircraft Development Corporation

THE FINISHED METAL-CLAD *ZMC-2*, "THE TIN BALLOON"

The *ZMC-2* (See page 730) is covered with 0.0095-in. sheet aluminum, which is "sewed" to the structure by about 3,500,000 rivets, 0.035 inch in diameter. The lifting gas is carried directly inside the hull with no internal gas bag except a bottom fabric membrane which allows for gas expansion and contraction.

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Courtesy Boeing Airplane Company

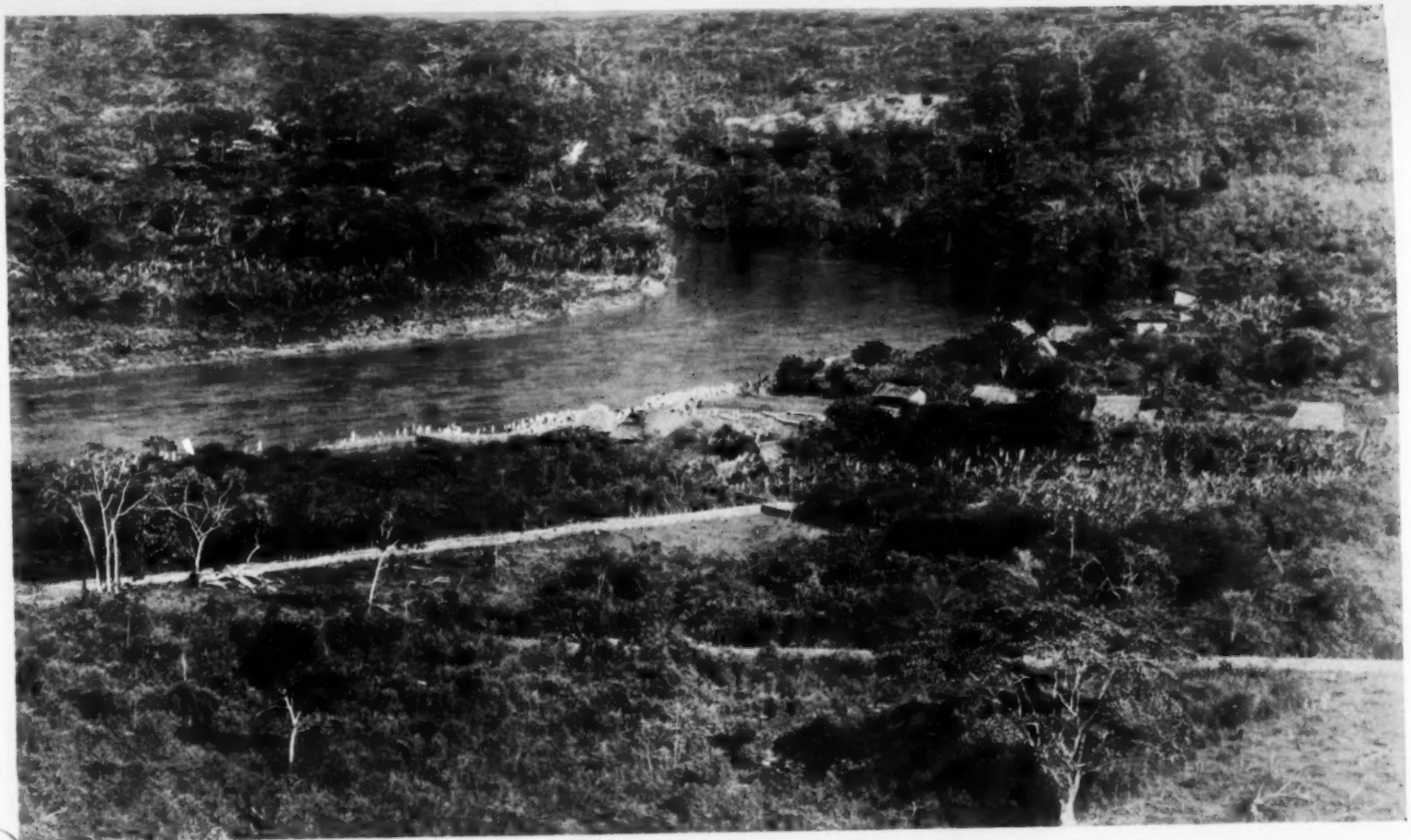
BOEING 40-B-4 FOUR-PASSENGER MAIL PLANE IN FLIGHT NEAR MOUNT RAINIER

Courtesy Captain H. B. Grow, Inspector General of Aviation, P.N.

UPON THE CLOUDS BETWEEN IQUITOS AND CONTAMANA

Courtesy Captain H. B. Grow, Inspector General of Aviation, P.N.

UPON THE CLOUDS BETWEEN IQUITOS AND CONTAMANA



Courtesy Captain H. B. Grow, Inspector General of Aviation, P.N.

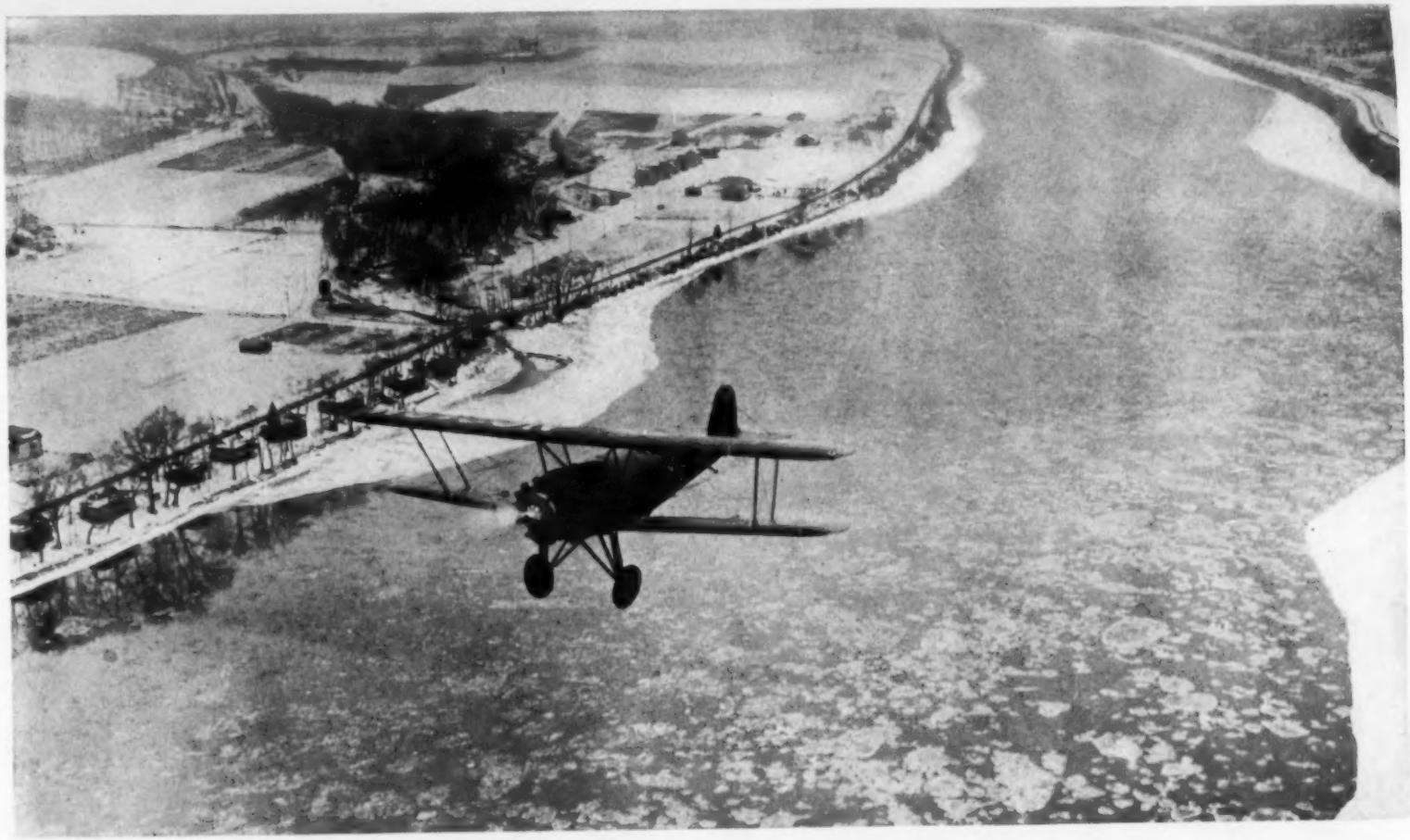
A LANDING PLACE FOR SEAPLANES AT MOYOBAMBA

UNIV. OF MICH.

Courtesy Captain H. B. Grow, Inspector General of Aviation, P.N.

AIR BASE AT IQUITOS

Courtesy Captain H. B. Grow, Inspector General of Aviation, P.N. AIR BASE AT IQUITOS



Courtesy Wright Aëronautical Corporation

PITCAIRN (WHIRLWIND 300) MAIL PLANE CROSSING THE DELAWARE

This crossing is being made just below the point where Washington and the Continental Army crossed more than 150 years ago.

UNIV. OF MICH.

Courtesy Navy Department, Washington

THE U. S. FLEET SORTIE, HAMPTON ROADS, PRIOR TO THE REVIEW BY FORMER PRESIDENT COOLIDGE

The aircraft carrier *Langley* is in the foreground.

The Formation *of* Ice *on* Aircraft

By LIEUTENANT V. O. CLAPP, *U. S. Navy*

AËRONAUTICAL experts emphasize the fact that ice formation on planes seldom occurs. It does, however, become a menace in individual cases and a complete account of its occurrence is most desirable. Such an account will help the meteorologists to issue a timely warning and the pilots to foresee the indications in time to avoid the danger; and it may also open the way towards its technical control or prevention.

In ordinary commercial air transportation cases of ice formation are not frequent; but in altitude flying and transoceanic or other long-distance flights it occurs more frequently, since it becomes necessary at times to fly through extensive cloud areas. However, there have been cases where regular transport planes have had to land or seek different levels in order to avoid this danger, which occurs not only in fog or cloud flying, but also while flying through rain falling from a warm to a colder strata, and where the temperatures are freezing or just below.

In January of this year the Bureau of Aëronautics authorized upper-air soundings by plane at the Naval Air Station in Seattle. Since that time the writer has sought to make these as regularly as possible, under all weather conditions, in an effort to determine actual flying conditions in that region and to obtain weather information in general. Ice formation in some form was encountered eighteen times out of a total of sixty flights. A complete record of each flight was obtained from an aërograph on the plane, recording temperature, pressure, and humidity at the time of the ice formation. Surface conditions were recorded at the field previous to the take-off.

In fog or clouds when the temperature was freezing or below, an ice coating was formed by the subcooled water droplets congealing as they struck the leading edge of the wings, struts, propeller, etc., the temperature of which was likewise below freezing. It is necessary, however, to discuss in more detail the nature of the deposit. When the temperature was —5° C. or lower, this ice deposit was similar to the ordinary frost on a cold winter morning. It is formed through sublimation and consists of fine ice crystals having a needle or flaky appearance, which arrange themselves in the direction of flight. This type of deposit scarcely affects the maneuverability of the plane, and causes no trouble by changing the characteristics of the propeller or air foils. It never became thick enough so that the increased load necessitated a landing. It would form when the cloud was very thin and may be even unnoticeable. The relative humidity would be between 50 and 90 per cent and the altitude was usually 7,000 feet or above.

When the temperature was from 0°C. to —3°C. the droplets became larger, and would strike the plane and run together before congealing, thus forming a solid ice coating or glaze on all exposed parts. This deposit has a bad effect upon maneuverability. It increases the weight, destroys the profile, and decreases the lift. The motor begins to lose its r.p.m., the air speed drops, and the plane begins to fall. All this happens in less than a minute, the ice forming almost *instantaneously*, and shortly thereafter the plane becomes unmanageable. The height at which this occurred was between 3,000 and 6,000 feet, and usually in a cumulus or cumulo-stratus cloud, more often the latter, which was supersaturated in regard to ice. Each time the hygrometer registered a relative humidity of 100 per cent.

It is impossible to say how far a plane can fly through a subcooled fog or cloud. Sometimes we were able to fly for fifteen or twenty minutes and come out above the cloud without hindrance. At other times very shortly after entering the base of the cloud, the ice would form with violent sud-

denness. The following table will illustrate when the ice formation in a cloud or fog is most likely to occur:

Temperature	—.5°	—1°	—2°	—3°	—5°	—6°	—10°
Ice formation rime	1	2	4	1			
Frost formation				4	2	3	1

From these figures it may be seen that frost occurs most frequently with temperatures around —5°C. and ice around —2°C. Frost, therefore, occurs with the lower temperatures and usually with the higher stratiform clouds, while ice is more frequent in the lower stratus and cumulus clouds. The conclusion is, that, when the temperature approaches the above values, flying in that region becomes especially dangerous. However, as said before, under almost identical conditions, ice may occur or it may not.

In the writer's opinion there is one element or property besides subcooling responsible for the probability and suddenness of ice formation; i.e., the frequently strong supersaturation with regard to ice. The cloud or fog is not only subcooled but supersaturated in addition. At negative temperatures with which we are concerned, the supersaturation is easily computed as the difference between the observed relative humidity and that to be expected in case of saturation over ice. If a plane should meet with such supersaturation, ice or frost formation would occur, and we are probably justified in regarding the amount of the supersaturation as a measure of flying possibilities. Subcooling and supersaturation are common in temperatures below zero; but the intensity may vary. In the winter the stratus cloud may sometimes reach the ground, still the visibility may be sufficient to permit flying. Under such conditions the supersaturation extends from the ground up and the danger of ice formation is always present.

The danger of flying through supersaturated layers is increased if the plane and ice coating have a lower temperature than the surrounding air. To illustrate this we may cite an example from the cloud theory. If an ice crystal from a cold layer falls through a warmer but supersaturated cloud, then amorphous ice is deposited very rapidly on the crystal. It is believed that in this way the large hail stones may be explained. Thus, instead of an ice crystal, we assume a plane passes from a cold to a warmer supersaturated layer; at such time an intensive or even catastrophical ice formation is possible. One may ask if the plane does not assume the temperature of the surrounding air very quickly, especially the all-metal planes? The answer is: First, that the changes in elevation take place so rapidly as to make a certain lag in the temperature unavoidable; and second, the ice coating acts as a powerful insulator. This is apparent from the heat conduction coefficients of aluminum and ice: aluminum .34 to .48; ice .0057, .005, .0023 (depending on the nature of the ice).

The conditions just described may occur (1) during flights in surface inversions with fog and (2) when the plane descends from a cold to a warmer supersaturated layer.

From the data obtained in sixty altitude flights by the writer, inversions aloft are not common; but during the winter they occur frequently near the surface, and have been found up to 8,000 feet. In each case where the ascent was made through a stratus cloud layer, an inversion was found at the top of the clouds, which were normally even and well defined. As stated before, the danger of ice formation becomes a maximum where these inversions occur and where the temperature is favorable.

Sleet will not lead to ice formation, but falling rain that hits the plane and freezes may affect the maneuverability. The amount of the deposit, however, depends upon the time the plane remains in the rain, seldom exceeding a limited amount.

It is of vital importance to the pilots of mail and transport planes, whose routes lead over mountains, to become familiar with the conditions of ice formations in order to avoid them before it is too late. The dangerous conditions may be recognized and avoided by locating an ordinary thermometer on a strut where it is visible to the pilot.

In making these flights we landed each time shortly after encountering ice or rime formation, and on two occasions it was necessary. After landing, ice still adhered to the wings and struts, sometimes being one-half inch thick. Frost formations never interfered with the flight, and had usually disappeared by the time we landed.

Airship Engines

By LIEUTENANT T. G. W. SETTLE, *U. S. Navy*

THE only fully developed and tried airship engine in existence today is the Maybach. In the early years of development of the rigid airship* on the shores of Lake Constance, Count Zeppelin realized the fundamental need of a trustworthy airship engine, designed and developed solely to meet the particular needs of his new type of vessel, and consequently he formed, under the leadership of Dr. Karl Maybach (senior), a Zeppelin subsidiary to prosecute engine development. As in the case of any such task, there were many rocks and shoals along the road of this development in the years that followed. But the performance of the Maybachs, as well as that of the vessels which they drove during the thousands of hours of acting as eyes for the High Seas Fleet and on bombing raids during the World War, must have been keenly gratifying to the old count. The practically perfect performance of the latest model of this engine, in the great voyages of the *Graf Zeppelin,* is well known to everyone.

Up until the war it was not surprising that there was only one engine development for airships, since the Germans were the only nation building these craft and the Zeppelin Company was the outstanding group so engaged in that country. However, since the war, both the British and ourselves have built and operated airships, and it is indeed surprising that neither has yet perfected a power plant. True, the British only embarked seriously on engine development specifically for airships at the time that the present ships, *R-100* and *R-101,* were authorized, and they deserve every praise for their courage and perseverance in installing the Beardmore compression ignition engine in their *R-101;* the time was too short fully to realize their hopes for this engine.

The particular requirements which an airship engine must meet may be listed as follows:

(1) *Reliability and durability.*—These must be manifested by ability to be run continuously for days at a time; the running times between overhauls must be reckoned in thousands of hours, instead of in hundreds.

(2) *Low specific fuel consumption.*—The fuel load in an airship is large compared to the whole engineering department weights and, therefore, low specific fuel consumption is relatively a more important consideration than engine weight itself; a lower specific fuel consumption will pay for heavier engines after a few hours under way; low fuel consumption steps up the inherently large cruising ranges and seakeeping ability of the airship.

(3) *Low specific weight.*—Contingent however upon (1) and (2).

(4) *Availability of full astern s.hp.*—Preferably internally reversible rather than by gearing and absolutely necessary for maneuvering the ship for reasons analogous to those requiring reversibility in surface vessels.

(5) *Absolutely positive and quick maneuverability.*—For same reasons as in surface vessels.

(6) *Best propeller speeds are about 1,000 r.p.m.*—Engine speed should not be much above this, unless gearing is dictated from other considerations, as in our new airships (where engines are inside hull and an outboard bevel-reduction gearing is used), and even then the gear ratio should be kept to a minimum.

(7) *Engine must cool properly* while ship is maneuvering, that is, at no or small air speeds.

* In this article "airship" will be used in the sense of the large rigid airship; nonrigid airships (blimps) are radically different in their power plant requirements, and to date have successfully utilized engines designed for airplane use.

(8) *Must be safe,* especially from fire and destructive vibrations.

(9) *Repairs.*—Must be capable of having minor repairs and certain major ones performed under way.

(10) *Large unit horsepower ratings.*

Through some curious psychological twist most laymen, and many naval officers, seem to believe that it should be perfectly all right to use airplane engines in an airship, although these same persons would never think of recommending the use of a racing car engine in a transcontinental motor bus, nor destroyer type turbines in a battleship or a tramp steamer. The only cause of which one can think for the above curious, but very common, view is that both airships and airplanes "go to sea" in the air. It is believed that everyone is sufficiently familiar with the engine requirements of airplanes to recognize the absurdity of this contention, after pondering the airship engine requirements listed above. It will be seen that the characteristics of the two types of engines are divergent on practically all points. With the further development of both types, this divergence gives promise of widening still more.

The latest Maybach engines, such as those of the *Graf Zeppelin* and those to be used in our two new airship scouting vessels, are of 560-hp. rating (sea level) at 1,600 r.p.m., with a compression ratio of seven to one. The engine is a 12-cylinder, 60-degree V-design, water-cooled, with aluminum pistons and crankcase, Maybach carburetor, and Bosch magnetos. All bearings in the engine are antifriction, the main and connecting-rod bearings being roller. Fuel consumption of 0.45 lb. per horsepower hour is realized. The Maybach carburetor is designed to function at will as a mixing valve for gaseous fuel, and the engine operates exceedingly well on such fuel. The weight of this engine, dry, but with its two-stage air compressor attached, is approximately 2,500 pounds. The air compressor keeps two flasks, mounted under the engine, topped up to thirty atmospheres for starting. The starting air is routed through a distributor to the individual cylinders of one bank.

Reversibility is obtained by having two complete sets of cams on the camshaft, an ahead set and an astern set. To reverse the engine, the throttle is closed and, just before the engine stops, the camshaft is shifted longitudinally in its bearings, to bring the other set of cams under the push rod can followers; then the engine is immediately ready for a start in the opposite direction.

Lubrication is not forced feed in the conventional sense. Oil is supplied under pressure (to maintain flow) to the connecting-rod bearings, but once in these bearings, centrifugal force and general oil mist provide for the lubrication of the remaining surfaces. The dry sump principle is used and a ventilating and cooling air flow is maintained through the crankcase.

The *Graf Zeppelin's* engines have run in the neighborhood of 1,000 hours between overhaul, much of which time has been at full power, and without noticeable reduction in performance prior to overhaul.

The *Graf Zeppelin* uses for a cruising fuel a hydrocarbon gas of a specific gravity relative to air slightly greater than unity. She also carries a quantity of liquid fuel (80 per cent benzol, 20 per cent benzine) for use during maneuvering (liquid fuel is more certain for maneuvering the engine) and to lighten ship when necessary under way. We do not anticipate using gaseous fuel in our new helium ships.

The only other engine "on the horizon" at present which seems to give any promise of eventual evolution and development into a reliable and serviceable power plant for airships, is the British Beardmore compression ignition engine, which has been installed in their *R-101.* Accurate data on this engine are not available, but it is believed to be excessively heavy and to have many other shortcomings which only years of effort can hope to overcome. However, as pointed out above, the British deserve much credit for attacking this problem and carrying forward the task of engine development to the point of obtaining an engine which they have used in one ship, however imperfect this engine may now be.

Endeavoring to look into the future, all signs seem to point to the airship engine of the future being of a compression ignition type, using heavy oil fuel. The reasons lie in the fundamental requirements for this service as laid down above, chief among which are reliability, low fuel consumption, and reduced fire hazard. The general line of airship engine development, it seems, must follow the same channel that the sub-

marine engine passed through in evolving from gasoline to the Diesel type, and for analogous reasons. There are many analogies and similarities between airships and submarines both in ship handling and in engines.

Another definite and necessary trend discernible in the development of airship engines for the future is toward higher-powered units. Airships themselves will without doubt expand in size very rapidly in succeeding classes for many years to come. In order to get the power required into these "bigger and better" ships, without incurring the undesirable features of a large number of low-powered units, we must have airship engine units of 1,000 horsepower and above. Even in our two airships now under contract, the use of four or five engines of 1,000 to 1,100 horsepower would have been very desirable in place of the actual installation of eight 560-horsepower units, had such higher-powered engines been available.

Following the above too brief discussion, certain conclusions and statements may be listed on the subject, as follows:

(1) There is only one bona fide airship engine in the world today—the Maybach.

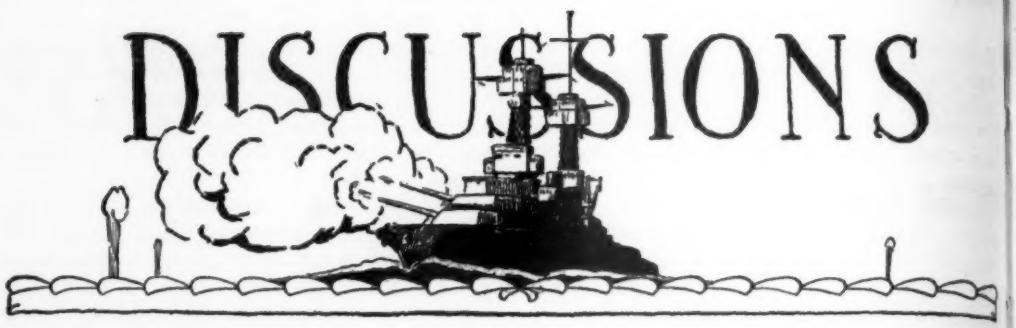
(2) There is only one other apparently serious effort towards developing an airship engine—the British Beardmore compression ignition.

(3) The airship engine is radically different and serving in an entirely different "environment" from engines of other craft; more particularly, it is different from an airplane engine. It gives promise of diverging further from the latter. The airship engine and its environment are more analogous to submarine practice than to that of other types of craft.

(4) The airship engine of the future will probably be compression ignition, heavy oil burning, of 1,000-horsepower rating and probably above, 1,000 to 1,500 r. p. m. at full power, and conforming to the other requirements laid down in the beginning of this article.

(5) It is rather disgraceful after a decade of active interest in and experience with airships, that the United States has to use foreign engines in its airships. More disheartening still is the fact that there is apparently no serious effort here to even start the development of such a power plant. The development will require years, and probably an enormous amount of money and effort. The longer that we delay starting this development, the longer it will be naturally, until we get a serviceable engine, and the more costly will be the effort. Our manufacturers of other types of engines, who are probably technically qualified to undertake such work, show no apparent interest whatever. The long history of grief with our submarine engines is well known to naval officers, and we seem doomed to an even sadder future in regard to airships, the only alternative being to use foreign engines indefinitely.

DISCUSSIONS



The College, the Technical School, and the Naval Academy

(See page 123, January, 1930, PROCEEDINGS)

Captain Ralph Earle, *U. S. Navy (Retired), President, Worcester Polytechnic Institute.*—First of all I have to thank Commander Rossell for bringing out such a valuable study of engineering education, and I appreciate greatly having this information at hand in a form so readily usable. His article has put into concrete outlines the many problems that confront the technical school of today. As to one of these it is well to point out in the beginning that there does not appear to be any prospect of lengthening the four-year course, as the great majority of young men find it impracticable to stretch out their school time. The necessity of obtaining the best practical education possible in four years seems to increase rather than diminish as the years go on. Over 50 per cent of our students must earn their living in whole or in part while attending college, a condition which makes it imperative to give them the best education possible in four years, and to make that education of a style which will enable them in the shortest possible length of time to capitalize it.

The discussion herewith of Commander Rossell's article follows his general presentation of the subject and incorporates the various opinions of the staff of one of the schools he has chosen in his study.

The mission of the Worcester Polytechnic Institute, in particular, and of engineering education in general is as follows: Engineering education is primarily a training for leadership in industry and commerce. Its broader aim, however, is to develop in young men the qualities of character and personality, that they may give the highest service and gain the most desirable things in life. In other words, we are now, and definitely propose to continue to be so in the future, a medium-sized—600 is the maximum enrollment—high-grade engineering institute.

For our entrance requirements we depend largely upon certificates of scholarship from the headmasters of college preparatory schools, without substantiating examinations. There has been much discussion of this system with the result that we feel such entrance requirements are fair and are working out well and that the only change, if any, that will be made in the near future is to model after our Naval Academy and require a substantiating examination in certain mathematical subjects and in English. Such an arrangement may prevent the entrance of students who have been given undeservedly high rating in school work and who are unfitted for our work. Certification is usually honest, however, and should tell much more fairly about a student's capabilities than can any set of examinations which may be devised, although the review necessary in order to pass these examinations may be an extremely helpful boon in his college course. This review feature appeals to me as the strongest argument for the substantiating examination. For the award of matriculation scholarships we do require all entrance examinations to be taken; there seems no other way open. The one thing that possibly may be gained by substantiating examinations in certain subjects is a reduction in the number of students failing to complete their courses. A lamentably small number do complete their work in the four years allotted, some 33.6 per cent, while an additional 10 to 15 per cent do eventually graduate in five or six years, and these comprise in larger part

those whose efforts to earn their living have deprived them of both the time and the physical energy requisite to better their record.

In the main, by special effort, it is attempted to weed out unfit students during their freshman or fourth-class year. Some success has resulted from certain standards for this period made arbitrarily in recent years, but it is exceedingly difficult to predict a student's eventual success whether he enters by certification or by examinations in whole or in part; and so satisfying entrance requirements, while giving an indication of ability, is not as good as the results of the first-year work. Naturally we do not wish to place emphasis upon that year as a probational year, because frequently students do not find themselves till years later, but, on the whole, it seems best to eliminate at the end of the first year those whose scholastic record and personal character lead me to anticipate that they may not succeed in becoming engineers.

Four years seems all too short to give a thorough engineering education, measured by the standard of familiarity with latest machines and systems and structures, but it is enough to give the real specific technology upon which the student's intelligence is quickened and cultivated. Without intimate association with the details of practice and application of the basic laws this so-called fundamental instruction would, for most of us, students, professors, and others, result in just a generalization of platitudes linked up with nothing in particular and so not only soon, but the sooner forgotten.

Content of curriculum is not so important as is the success of the teaching not alone in the study of the individual and consequently in the leading of him rather than the driving, but also in its effectiveness along the lines of keeping it alive and modern and so stimulating interest and thereby increasing the power of the student to absorb and retain. The instruction imparting is difficult, yet its success is certainly the criterion by which a college must be judged. Our Naval Academy has in this feature something that colleges cannot secure and thereby it has an immeasurable superiority. By this something is meant the ever-changing personnel of the instruction staff whereby fresh knowledge of a practical nature coupled with new enthusiasm for the teaching game is constantly entering into the education and training of the students, the midshipmen. The best that colleges can do along these lines is the granting of Sabbatical leaves of absence, leaves that never fail to result in benefit to the college through the renewed vigor of the teacher and through the new ideas that contact with the practical world and release from the restrictions of academic life have granted. This, however, does not automatically maintain content and teaching of courses in the curriculum abreast or ahead of technical progress and thought as is the case at the Naval Academy, where the changes and progress, though constant and automatic as one may fairly describe them, are slight in themselves, but nevertheless great in the aggregate.

Most of those teaching in technical schools feel that somehow cultural subjects are not given the place they should have, either in type or time. We feel that the lack of this may be compensated for in large measure by the way a technical subject is taught, and yet, while the contacts which may be made with history, art, and philosophy, are surprisingly great, we find that the restrictions of personality and education limit the good that can be obtained in this way. Thus while technology and culture are not far apart, it is difficult to narrow the gap. At the Institute much use is made of English and modern languages to not only increase cultural knowledge but also to quicken the desire therefor through biography, poetry, music, and literature, and then by debate develop in some degree confidence in speaking.

It seems quite impossible to curtail mathematics or technical studies in order to increase the time given to the cultural ones, and so perhaps modern language may have to give more of its time to strictly cultural instruction. Lengthening the course to five years is the simplest way, but it is, as explained above, an impracticable way. We do have an optional five-year course where the fourth year is taken away from the college, with industry, and it is possible in that period for the student himself to develop and produce a thesis that will involve reading and research in strictly cultural fields. I have always felt that the third year at the Naval Academy should be spent at sea, making the total time of a midshipman five years, and since seeing what a year with industry

does to the technical student, I am more convinced than ever that such a scheme would be a benefit to our Navy as a whole.

Business law, economics, and government are given more time at the technical schools than at the Naval Academy and yet they are of great value and well worth, in my humble estimation, the time proposed by Commander Rossell to be given them by reducing the time now allotted to certain technical studies. In addition, it would be well to include some instruction in personal and business finance, and in business administration involving contracts and so on. I would be glad to see the alterations proposed by Commander Rossell adopted *in toto*, for I can see only great good as a result. Such a change taken whole-heartedly would certainly benefit the individual midshipman and through him the entire Navy.

The Spherant

(See page 607, July, 1930, PROCEEDINGS)

LIEUTENANT COMMANDER L. B. SCOTT, *U. S. Navy*.—The spherant is correct in theory and the idea involved is the most revolutionary and progressive one since Sumner laid down his first line of position. This instrument will probably take hold immediately among air navigators. It should find a permanent place aboard ship if or when:

(1) It is sufficiently rugged and its mechanical and optical features so simple that the navigator can check and maintain the adjustment of the instrument aboard ship.

(2) Its cost is not too prohibitive.

(3) The average navigator can be convinced that the instrument actually *measures* hour angle just as accurately as the sextant measures altitude.

It does not appear that the practical operation of spherant is particularly difficult. In using the sextant for measuring altitude we revolve the image of the body about the axis of the telescope, at the same time completing coincidence by adjusting the altitude vernier. In using the spherant we revolve the horizon image (intersection) about the axis of the telescope, at the same time completing coincidence by adjusting the hour-angle vernier.

Professor Kaster's line of position, of course, is practically the same as that obtained by the old Chard method, except it is slightly in error in direction, the amount depending upon the movement of the observer between the two observations of the body. This, however, is of no consequence if observations are taken within one minute of each other.

The idea of the spherant is sound and progressive. The designer, however, should not feel discouraged in case his instrument does not achieve immediate general adoption. It took twenty years for Godfrey's (Hadley's) octant to supersede the astrolabe.

PROFESSIONAL NOTES

JUNE 2 TO JULY 1

COMMANDER D. B. BEARY, U. S. NAVY
LIEUTENANT COMMANDER D. C. RAMSEY, U. S. NAVY
AND
PROFESSOR HENRY BLUESTONE, U. S. NAVAL ACADEMY

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UNITED STATES

Eight New Cruisers to Augment Fleet

New York *Times*, June 7.—The Navy Department announced today plans for incorporating eight new 10,000-ton cruisers of the so-called *Chicago* class into the fleet as the first step in the cruiser replacement program.

The *Salt Lake City*, which has completed her shakedown cruise and passed final acceptance trials, has been tentatively assigned to Light Cruiser Division 2 of the scouting fleet.

The *Pensacola*, sister-ship of the *Salt Lake City*, is now at Newport. She will dock at New York on June 9, then run her final acceptance trials at Rockland, Me., after which she will be tentatively assigned to Light Cruiser Division 3, scouting fleet.

The assignments of the *Salt Lake City* and the *Pensacola* will be changed about September 14 on the return of the cruiser *Northampton* from a Mediterranean shakedown cruise. The *Northampton* will become flagship of light cruiser divisions and Light Cruiser Division 5, scouting fleet, and will be joined by the *Salt Lake City* and the *Pensacola*.

Later in the year the *Chester*, to be commissioned at Philadelphia and sent on a Mediterranean shakedown cruise, will join Light Cruiser Division 5. The *Louisville*, now under construction at the Puget Sound navy yard, will be added to this division.

The *Houston*, which has just completed her preliminary acceptance trials, is scheduled to relieve the *Pittsburgh* as flagship of the commander in chief of the Asiatic Fleet, in the early summer of 1931.

Assignment of the *Augusta*, now building at the Newport News Shipbuilding and Drydock Company, and the *Chicago*, building at the Mare Island navy yard, the last of the eight cruisers of the so-called *Chicago* class authorized by Congress on December 18, 1924, is still in question. Both of these ships are fitted as flagships.

Of the eight cruisers of this class, two—the *Salt Lake City* and *Pensacola*—mount ten 8-inch, 55-caliber guns, and the remaining six mount nine guns of the same size and caliber. Each ship mounts four 5-inch, 25-caliber antiaircraft guns, two 21-inch triple, above-water, torpedo tubes and is designed to carry from four to six scouting airplanes. Designed speed is 32.5 knots.

Vessels Under Construction, United States Navy, Progress of May 31, 1930

Type Number and Name	Contractor	Per cent of Completion				Probable date of Completion
		June 1, 1930		May 1, 1930		
		Total	On Ship	Total	On Ship	
LIGHT CRUISERS						
Northampton (CL26)	Bethlehem S. B. Corp. (Fore River)					Del. 5/17/30
Chester (CL27)	American Brown Boveri Elec. Corp.	98.	98.	94.8	94.8	6/13/30
Louisville (CL28)	Puget Sound Navy Yard	85.1	83.7	80.8	79.5	3/13/31
Chicago (CL29)	Mare Island Navy Yard	82.4	77.5	79.	74.2	3/13/31
Houston (CL30)	Newport News S. B. & D. D. Co.	98.9	98.9	95.6	95.6	6/13/30
Augusta (CL31)	Newport News S. B. & D. D. Co.	78.6	78.4	76.4	76.2	3/13/31
New Orleans (CL32)	New York Navy Yard	2.9	1.2	2.9	1.2	12/ 1/32
Portland (CL33)	Bethlehem S. B. Corp. (Fore River)	15.6	8.1	12.6	6.2	8/15/32
Astoria (CL34)	Puget Sound Navy Yard					4/ 1/33
Indianapolis (CL35)	New York Shipbuilding Co.	12.	6.2	10.2	5.5	8/15/32
Minneapolis (CL36)	Philadelphia Navy Yard					9/ 1/33
FLEET SUBMARINES						Comm.
V-5 (SC1)	Portsmouth Navy Yard					5/15/30
V-6 (SC2)	Mare Island Navy Yard	97.	95.1	95.9	93.5	9/ 1/30
V-7 (SC3)	Portsmouth Navy Yard	3.3	3.3	1.9	1.9	8/ 1/32

Authorized by Act of August 29, 1916.

12 Destroyers Nos. 348 to 359 inclusive—no funds for construction.

1 Transport No. 2—no funds for construction.

2 Fleet Submarines Nos. 170 and 171.

1 Neff Submarine No. 108 —no funds for construction.

Authorized by Act of February 13, 1929.

10 Light Cruisers.

1 Aircraft Carrier.

Data on Modernization of Battleships

Senate Document, No. 548

Ships	Date of completion of modernization	Navy yard at which modernized	Guns elevated	Blisters[1]	Blister drainage	Deck protection added	New boiler and oil burning installation	Modernized main propulsion machinery	Cost
Florida	Nov. 1, 1926	Boston	No	Yes	No	Yes	Yes	[2]	$ 3,852,500
Utah	Oct. 28, 1927	Boston	No	Yes	No	Yes	Yes	[2]	3,784,500
Wyoming	Nov. 2, 1927	Philadelphia	No	Yes	No	Yes	Yes	[2]	3,539,000
Arkansas	Nov. 21, 1926	Philadelphia	No	Yes	Yes	Yes	Yes	[2]	3,329,000
New York	Oct. 10, 1927	Norfolk	No	Yes	[3]	Yes	Yes	[2]	3,030,000
Texas	Nov. 23, 1926	Norfolk	No	Yes	.....	Yes	Yes	[2]	3,325,000
Oklahoma	Aug. 14, 1929	Philadelphia	Yes	Yes	Yes	Yes	Yes	[2]	6,763,450
Nevada	Aug. 21, 1929	Norfolk	Yes	Yes	Yes	Yes	Yes	[2]	6,799,727
Pennsylvania	Mar. 1, 1931	Philadelphia	Yes	Yes	Yes	Yes	Yes	[2]	[4] 14,800,000
Arizona	Mar. 1, 1931	Norfolk	Yes	Yes	Yes	Yes	Yes	[2]	[4] 14,800,000
New Mexico	.....	.....	.....	.....	.....	.....	.....	.....	10,101,250
Mississipi	.....	.....	.....	.....	.....	.....	.....	.....	9,821,250
Idaho	.....	.....	.....	.....	.....	.....	.....	.....	9,871,250
Tennessee	.....	.....	.....	.....	.....	.....	.....	.....	.....
California	.....	.....	.....	.....	.....	.....	.....	.....	.....
Colorado	.....	.....	.....	.....	.....	.....	.....	.....	.....
Maryland	.....	.....	.....	.....	.....	.....	.....	.....	.....
West Virginia	.....	.....	.....	.....	.....	.....	.....	.....	.....

[1] With regard to blisters, due to faulty design, trouble has been experienced on the *Florida* and the *Utah*. No trouble has been experienced with later installation other than minor leakage which can readily be handled by the drainage systems that are being installed. As experience has been gained in successive installations, minor changes in design have been effected.

[2] On the *New York*, *Texas*, and *Oklahoma* only minor alterations were effected in the reciprocating engine installation. On the *Florida Utah*, *Wyoming*, and *Arkansas* new cruising turbines were installed and other minor alterations made. On the *Nevada* the turbines of the ex-*North Dakota* were installed. On the *Pennsylvania* and *Arizona*, new cruising and new main turbines with reduction gears are being installed. On the *New Mexico*, *Mississippi*, and *Idaho*, the proposed modernization of the main propelling machinery will be much more extensive.

[3] Now authorized next overhaul.

[4] Cost estimated for both vessels.

Four Cruisers Named

Washington *Post*, June 4.—The four new 10,000-ton cruisers will be named the *Portland*, *Astoria*, *Minneapolis*, and *New Orleans*, it was announced by Secretary of the Navy Adams last week.

The *Portland*, named for the Maine city, is under construction at Quincy, Mass.; the *Astoria*, at Puget Sound navy yard; the *Minneapolis*, at the Philadelphia navy yard; and the *New Orleans* at the New York navy yard. The fifth cruiser of this year's program already has been named the *Indianapolis*.

GREAT BRITAIN

Completion of the "Codrington"

London *Times*, June 4.—H.M.S. *Codrington*, the first post-war flotilla leader to be designed and built for the Royal Navy, is due to be completed today at the works of Swan Hunter and Wigham Richardson, Ltd., Wallsend-on-Tyne. The *Codrington* has been built under the 1927 navy estimates, and is of 1,520 tons. Her geared turbine machinery has been manufactured by the Wallsend Slipway and Engineering Company, Ltd., and is of 39,000 horsepower, giving a speed at standard displacement of 35 knots. The armament includes five 4.7-inch guns, seven smaller guns, and eight torpedo tubes.

New Destroyers

London *Times*, June 5.—Dates have been approved for the launching of two more destroyers of the 1928 program. The flotilla leader of the program, H.M.S. *Keith*, will be launched from the Barrow works of Vickers-Armstrongs, Ltd., on July 10; and the destroyer *Boadicea* will be launched from the yard of Hawthorn Leslie and Co., Ltd., Newcastle-on-Tyne, on July 28. Two destroyers will thus take the water from Tyne yards within a week, as the *Brazen*, at Palmers' Shipbuilding and Iron Company, Ltd., Jarrow, is due to be launched on July 25. So far only one vessel of this group has been launched, the *Blanche*, at Hawthorn Leslie's yard on May 30. The four other destroyers of the program are the

Basilisk and *Beagle,* building on the Clyde, and the *Brilliant* and *Bulldog,* at the Swan Hunter yard on the Tyne.

Naval Construction

London *Times,* May 22.—Orders have been given for work to proceed on the 6-in.-gun cruiser (*Leander*) to be built at Devonport and on the two destroyers to be built at Portsmouth; the preparation of material for construction has already commenced. Tenders for the leader and the two remaining destroyers, which will be built by contract, are now under consideration. It is proposed to proceed forthwith with the building of the three submarines. Two will be of approximately 650 tons each, and one of approximately 1,800 tons. The two smaller submarines will be built at Chatham dockyard and the larger one by contract.

This construction was part of the 1929 program that was not canceled. A considerable portion was canceled. The three submarines were part of the six approved by Parliament on the 1929 construction program. Three were canceled.

FRANCE

Destroyers and Ideal Torpedo Boats

Naval and Military Record, By J. B. Gautreau, June 18.—The last *torpilleurs d'escadre* of the *Simoun* class—that numbers twenty-six units—are entering the service. Contrary to what existed in pre-war times, the French boats are larger than English boats of corresponding type and date. The four *Fougueux,* just delivered by private chantiers, are larger by over 100 tons than the excellent British destroyers of the "A" series of 1,330 tons. There is a great resemblance in the general design, shape of the hull, and distribution of armament on board. They are instruments of warfare of like order, fit for the same jobs. British war experience told in favor of the smallest size compatible with adequate armament, speed, and nautical qualities. The French, having suffered much during the war from the undersize, weak armament, poor endurance, and nautical qualities of their so-called *contretorpilleurs* of the *Casque* and *Bouchier* class, wanted robustness, roominess, reliable sea speed first, together with superior caliber and range for both guns and torpedoes; and so far they have, on paper at least, achieved their object. Compared with pre-war *contretorpilleurs,* the latest batches of 1,500-ton so-called *torpilleurs d'escadre* are small cruisers, comfortable for their crews, good for 30 knots in choppy waters without strain for any length of time, and they can deliver harder blows at long range than their British rivals could do. French shells are heavier than the British by some 13 lbs., and French torpedoes are also heavier than the English.

The best point about the *Simouns* is that there are twenty-six of them, built on the same model in seven years, and that the comprehensive experience acquired in service has led to substantial practical improvements. All French officers are familiar with the handling and capabilities of those boats, which is a great point in their utilization in war. Similarly, the British *Acasta* class, being merely an improvement on the very numerous "V" and "W" classes, benefit, of course, from the same advantages, even to a greater extent, being more handy than the French from their shorter length, reduced draught, and lighter armament, while offering also a rather smaller target. As they are, the French 1,500-tonners give satisfaction, being ever ready to perform duties formerly entrusted to cruisers. The *Fougueux* (Chantiers de Bretagne, Nantes) has exceeded 36 knots, just like the British *Anthony.*

Such vessels, with a length of over 100 meters and exaggerated top hamper (though the funnels of the earlier boats have been shortened) are too costly and too vulnerable for torpedo work. They are rather fast gunboats and diminutive cruisers; their guns and sea keeping powers are their strong points. It is not intended to construct any more of them. The French Navy is now actively looking for the ideal *torpilleur,* for some counterpart to the 200-ton *kleine torpedobooten* that the fast-recuperating German Navy has the right to construct under the Versailles Treaty and is known to be silently and actively experimenting on. The 40-45-knot motor-vedettes being built wholesale by several French firms, and notably by the Chantiers de la Loire (St. Nazaire), are, despite their improving nautical qualities, only suited for coastal defense. The demand is now for

larger boats fit for high-sea work, and especially for night attacks. The value is obvious of swarms of 150-200-ton and 45-knot torpedo carriers, low on the water and practically invisible, based on well-selected strategic points *d'appui* and capable of being hurled, under cover of darkness, at an enemy passing within 100 miles or so. The torpedo, a traditional French weapon, is to be made the most of to strengthen the offensive capabilities of such bases as Corsica, Bizerta, Oran, and ultimately of colonial points *d'appui*.

The *Gerfaut*, first 2,700-ton unit of the 1927 program, was launched on the fourteenth at the Nantes Chantiers de Bretagne. She is on paper (2,480 tons Washington) larger by 20 tons than the excellent *Verdun* and *Valmy*, of which she is an improved copy. She is thus a promising craft. Nothing has been left to chance in her design, and she is partially built on lighter materials than her predecessors and embodies several minor improvements, and, moreover, she has been entirely (hull and motors) produced by a French yard that has specialized in research for speed and has achieved commendable results. She is to be delivered next January, as usual one year in advance of units of the same series ordered at Lorient or at Dunkerque.

ITALY

Cruisers in Ten Months

Naval and Military Record, June 4.—Signor Sirianni, Minister of Marine, introducing the naval estimates, providing for an expenditure of 620 million lire (£1,000,000) on new construction here today, said that building warships would be accelerated.

In future, 10,000-ton cruisers would be completed in ten months, instead of two years.

He declared that the new naval program, providing for one 10,000-ton cruiser, two flotilla leaders, four destroyers, and twenty-two submarines, was almost identical with those of previous years. The reason they were building so many submarines was because a number had become obsolete.

ARGENTINE

Torpedo-boat Destroyers "Mendoza," "Tucuman," and "La Rioja"

The Shipbuilder, June, 1930.—It will be recalled that in June, 1927, the Argentine government placed with Messrs. J. Samuel White & Co., Ltd., of East Cowes, Isle of Wight, a contract for both the hulls and propelling machinery of three large ocean-going torpedo-boat destroyers. This contract has now been completed, and the vessels—named the *Mendoza*, *Tucuman*, and *La Rioja*—are all in commission, acting as flotilla leaders in the Argentine Navy. The 5,860-mile voyage across the Atlantic from Lisbon to Bahia Blanca was carried out by each vessel without refueling, this constituting a much longer non-stop steaming than previously accomplished by any destroyer. On arrival, the machinery was found to be in perfect order, enough fuel remained in the bunkers for over 1,000 miles' steaming, and two days' supply of fresh meat was still available in the cold stores.

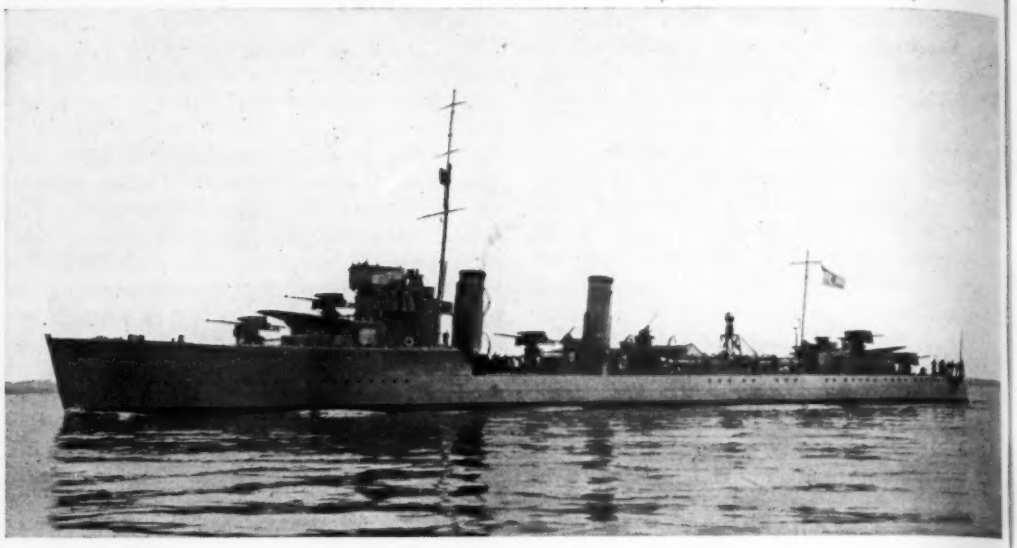
The designs and specifications of these destroyers were prepared by the builders to meet the requirements of the Argentine government. High speed, powerful armament, and ability to keep at sea in all weathers for long periods without refueling, together with the most modern and efficient equipment, were the principal features to be embodied in the designs. After completion, in order to ensure that all the specified conditions had been met, most exacting trials were carried out. The three vessels passed through these trials to the satisfaction of all concerned, with ample margins.

The principal particulars of the destroyers are as follows:

Length on load water line	330 ft. 9 in.
Breadth molded	31 ft. 9 in.
Depth molded	19 ft. 9 in.
Load draught	12 ft. 6 in.
Load displacement, tons	2,300

With a long forecastle, high foremast, two funnels, and wireless mainmast, the vessels present a very smart and efficient appearance. Including, as already mentioned, such qualities as exceptionally high speed and heavy armament, together with a much larger radius of action than any other vessels of their class, these destroyers, it is claimed, are the most efficient afloat.

The hulls have been constructed chiefly of galvanized steel; that used for the shell plating, keel, decks, girders, and other longitudinal strength members being of very high-tensile quality. In the design stage, great care was taken to ensure that the steel employed in the construction should



THE ARGENTINE TORPEDO-BOAT DESTROYER *TUCUMAN*

be distributed throughout the hulls in such a manner as to reduce the stresses set up when the vessels were steaming rapidly in heavy seas. In association with the careful elimination of needless weight in the outfit, this efficient distribution of the hull steel has resulted in great economies in the overall weights, thus making available weight margins for the installation of more powerful propelling machinery, and for the carriage of greater quantities of fuel, than would otherwise have been possible.

The main armament of each vessel consists of five 120-mm., 45-caliber guns, one 76-mm. antiaircraft gun, and two 40-mm. pom-poms with high-angle mountings. The 120-mm. guns have been arranged two at the fore end and two at the after end in superimposed positions, the remaining gun being mounted between the funnels. Very large angles of training have been secured for these guns. The 76-mm. antiaircraft gun has been placed abaft the after funnel, thus obtaining a practically unobstructed field of high-angle fire. Four machine guns with naval mountings and two bomb throwers complete the gun equipment. On the middle line over the engine-room are installed two sets of 21-in. triple, revolving torpedo tubes, arranged to project torpedoes over either beam.

Magazines and shell rooms have been arranged forward and aft for the stowage of ammunition. The supply of ammunition to the guns is provided by means of hand-up scuttles and whips. The torpedo bodies are stowed in the torpedo tubes and the heads in the steering-gear compartments. A bow paravane mine-sweeping gear has been fitted to each vessel.

The armament, as well as the ammunition, for all three ships has been supplied and installed by Messrs. Vickers-Armstrongs, Ltd.

A director-gun and torpedo fire-control system has been installed in each vessel by the Dutch firm of Hazemeyer, and comprises the necessary instruments fitted in a fire-control room on the forecastle deck under the bridge. Two 13-ft. range finders have been provided, one on the bridge and the other on the deckhouse aft, in connection with the director control. Arrangements have also been made for the local electrical firing of the guns.

Submarine-signaling, listening, and depth-sounding equipments of the latest types have been supplied and fitted by the Signal Gesellschaft, of Bremen. The wireless-telegraphy installation is by the Marconi International Marine Communication Co., Ltd., of London. The main wireless is situated on the bridge, and a secondary station is arranged in the after deckhouse. Both long and short wave transmitters and receivers have been provided.

A gyro compass of Messrs. Anschutz & Company's make has been installed in a special gyro compartment, with the gyro repeater fittings on the navigating bridge.

One 600-mm. high-intensity searchlight projector, with mechanical control, has been fitted on a raised platform over the engine casing, and two 300-mm. signaling projectors have been arranged, one on each side of the navigating bridge. These searchlight projectors have been made by the Sperry Gyroscope Co., Ltd., of London.

Accommodation has been provided in each ship for 160 officers and men. The petty officers' and men's quarters have been arranged forward on the lower deck and in the long forecastle. The warrant officers' quarters are also situated forward, with a large messroom in the forecastle deckhouse. Ample lavatory accommodation has been provided for the warrant officers, petty officers, and men.

The staterooms for the officers are on the lower deck aft, and include the captain's suite of a day cabin, sleeping cabin, bathroom, and pantry. A sea cabin for the captain has also been provided on the bridge. The remaining officers' accommodation consists of large, comfortable rooms and a spacious wardroom. Convenient lavatory arrangements have been provided, as well as a hot and cold water supply to each cabin.

Two galleys—one for the officers and the other for the crew—are included in the arrangements, and these have been provided with oil-fired cooking ranges. Ample space for the stowage of provisions has been allowed for, and a Frigidaire chamber has been supplied for cold storage.

The ventilating and heating arrangements have been specially considered with a view to rendering the interior of each vessel comfortable in all climates. A regulated temperature air supply, on the system of Thermotank, Ltd., of Glasgow, is delivered through punkah louvers to all living and working quarters. Steam-heated radiators have also been supplied in the officers' and crew's accommodation.

The propelling machinery of each of the destroyers consists of two sets of turbines of the Parsons type, each set being coupled through single-reduction gearing to its propeller shafting, and comprising a high-pressure and a low-pressure turbine, incorporated with which is an astern turbine. Steam is supplied by water-tube boilers of the three-drum type having a working pressure of 250 lbs. per sq. in., and arranged for oil firing on the "J. Samuel White" system.

After completion, each of these destroyers was taken on a measured-mile course for progressive speed trials and for consumption tests at full and cruising speeds. The performances of the *Mendoza, Tucuman,* and *La Rioja* were very similar, and the results here given may be taken as representing all three vessels.

The highest mean speed obtained on the measured mile with and against the tide was 39.4 knots, thus exceeding the contract speed by nearly 3.5 knots, without running the machinery in excess of the designed power. On the full-speed oil-fuel consumption trials, the quantity of oil burned was 0.9 lb. per horsepower per hour. To determine the radius of action of the vessels at cruising speed, a 12-hour fuel-consumption test was run at about 14 knots. While on trial, the steering gear of each ship was very severely tested, and proved amply powerful and robust under all conditions of steering. Gun and torpedo trials were also carried out with success; and exhaustive tests of all electric circuits, fire-control gear, ventilating and heating units, etc., were made.

CHINA

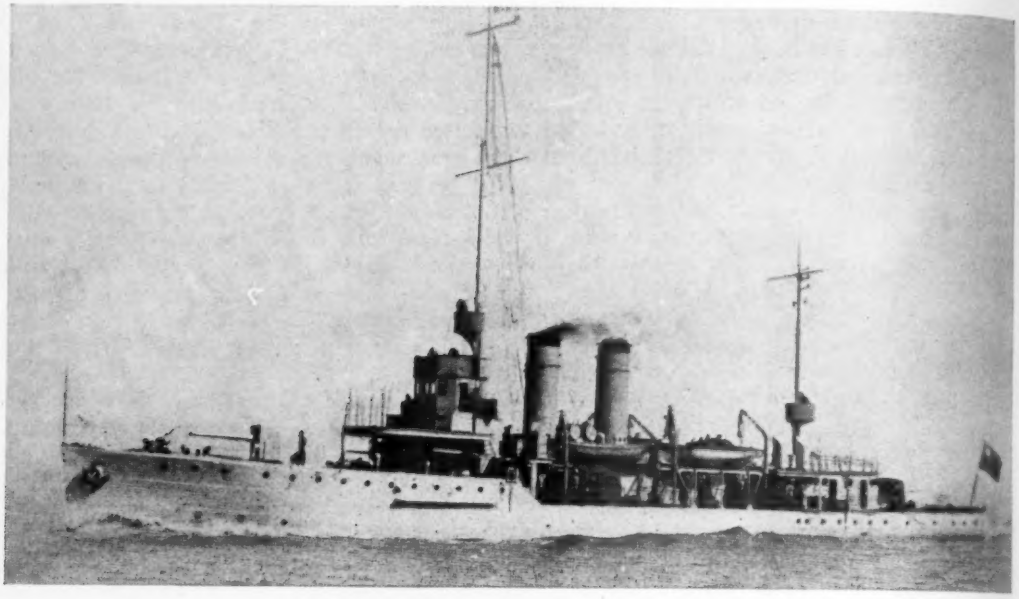
River Gunboat "Min Chuan"

Far Eastern Review, May, 1930.—The Kiangnan Dock and Engineering Works has just completed the river gunboat *Min Chuan* for the Chinese Navy. The principal dimensions of this new addition to the Chinese Yangtze patrol, are as follows:

Length over-all, 196 ft. 8¾ in.; length between perpendiculars, 183 ft. 4½ in.; breadth, molded, 26 ft. 0 in.; depth molded, 11 ft. ¾ in.; draft (normal) 6 ft.; displacement 460 tons; indicated horsepower 2,600; speed 18 knots.

Armament: One 4.7-in. q.f. gun on bow; one 4-in. q.f. gun on stern; three 6 pounders on bridge and forecastle; six machine guns on bullet-proof shield mountings.

Machinery: The propelling machinery consists of two sets of high-speed, inverted, direct-acting, surface-condensing, triple-expansion engines. Steam is supplied by two Thornycroft water-tube boilers at a working pressure of 250 lbs. per square inch.



CHINESE NAVAL RIVER GUNBOAT *MIN CHUAN*

Accommodation: Appropriate accommodation is provided for a total complement of 100 men.

MERCHANT MARINE

The French Motor Liner "Lafayette"

The Engineer, May 23.—The new French motor liner *Lafayette* called at Plymouth on the afternoon of Sunday last, May 18, on her maiden voyage from Le Havre to New York. She is the largest French motor vessel afloat and was built for the North Atlantic service of the Compagnie Général Transatlantique by the Chantiers et Ateliers de St. Nazaire Penhöet. With her single tall mast and single low tapered funnel she presents an appearance pleasing and yet different from that of other ships of the French line. Her over-all length is 610 ft., her beam 77 ft., her depth 50 ft., and her measurement over 25,000 gross tons. Passenger accommodation is provided for over 1,000 persons, including cabin, tourist cabin, and third-class travelers, each group having well-designed public rooms and cabin accommodation. The propelling machinery consists of four sets of M.A.N. six-cylinder, two-stroke, double-acting oil engines, two of which were constructed by the builders and two at the Augsburg works of the M.A.N. company. The engines have a total rated output of from 16,000 to 18,000 s. hp. at 145 r. p. m. and 150 r. p. m., respectively. The current for auxiliary lighting and power is provided by five oil-electric generator sets, three of which have a designed output of 700 kw and two an output of 500 kw. The deck machinery is operated on the Gilbert-Austin constant current system. On her recent trials the *Lafayette* attained a speed of 18.25 knots, but in actual service she is expected to maintain about 17.5 knots, making the crossing from Plymouth to New York in under seven days. The new motor liner will operate along with the 17,000-ton steamer *De Grass,* built by Cammell, Laird and Co., Ltd., in 1924, for the special service of the French line.

Marine Academy's Work

New York *Times,* June 23.—The New York State Merchant Marine Academy, under the jurisdiction of the State Education Department, is engaged in the work of training young men for the merchant marine service. Last year the name of the academy was changed from that of New York State Nautical School, which it had held since its establishment in 1874.

The school claims the distinction of being the oldest institution of its kind in the

United States. Its purposes are set forth in a recent bulletin, as follows:

> To educate and train the young men enrolled therein to be deck officers and engineer officers on ships of our merchant marine on the same principle that young men are trained at Annapolis to be officers in the United States Navy. The greater proportion of the large merchant ships entering and leaving the port of New York are officered by our graduates, from captain or chief engineer down to the junior officers on deck or in the engine-room.
>
> Young men between the ages of 17 and 20 inclusive, residing in New York State, who are of good moral character and who have completed satisfactorily two years of high school, are eligible for entrance to the academy provided they can pass the physical examination. The two years of high school work must include one year of algebra. As the number of applications for entrance is in excess of the number that can be admitted in each new class, a competitive examination is held throughout the state and resulting marks are combined with the mark assigned for adaptability and physical fitness. At present the new classes are limited to thirty-six cadets, of whom twenty-four are deck cadets and twelve engineer cadets.
>
> The course in the academy is two years, two classes entering each year, one on October 1 and the other February 1. Each year is divided into two terms, the academic term of two semesters from October 1 to May 31, and the practical term from June 1 to September 30. During the academic term the training ship *Newport* is moored to its winter base and academic instruction is given. During the practical term the training ship makes a foreign cruise, usually to European ports, and practical instruction in ship handling, navigation, and engineering is given. The cadets live on board ship during the entire course and perform all work in the upkeep, maintenance, and operation of the ship. Two classes are graduated each year, one on September 30 and one on January 31.

Courses of instruction are given in two branches, deck and engineering. Deck cadets learn navigation, seamanship, ship construction and stability, cargo stowage, maritime laws, mathematics, and ships' hygiene; engineering cadets learn marine boilers and engines and their auxiliary machinery, gas engines, electricity, mathematics, and ships' hygiene.

The deck cadets are taught the operation of sextants, sails, and steering gear while their engineer brothers are at the business of firing boilers, running the engines, and maintaining the machinery. Following graduation they go before the U. S. Board of Steamboat Inspectors for licenses as third officers and third assistant engineers, positions paying from $140 to $155 monthly.

From this the ambitious rise to the rank of captain or chief engineer, at the monthly stipend of as much as $600 plus. It is possible to attain this rank within four years.

During the sea term from June 1 to September 1 each year the training ship *Newport,* makes a foreign cruise. This year's cruise, starting June 18, was through the Mediterranean. Gibraltar, Villefranche, Leghorn, Algiers, and Ponta Delgada were among the ports of call.

The school information bulletin adds:

> Only young men of a rugged physique and resolute spirit are desirable. Cadets are required to sleep in hammocks and serve at table. Space on shipboard is restricted and consequently many consider it crowded—but such is life at sea.

One thing to be remembered, it concludes, in the selection of work is the fact that the engineer is better qualified than the deck officer for positions ashore, in the event it is necessary to give up a life at sea.

ENGINEERING

Cargo Vessel a Floating Power Station

Nautical Gazette, June 21.—New England is to have a new kind of electric generating plant—a floating one that can be towed to whatever section of the territory is in need of additional power. A very large part of the energy required by the subsidiaries of the New England Public Service Company is supplied by water power; but it is necessary to have a certain amount of steam auxiliary to furnish service in time of drought or in case of interruption to transmission lines. The markets are widely scattered throughout Maine, New Hampshire, and Vermont, the ones in Maine and New Hampshire being near the coast or on waterways.

By installing the generating equipment on shipboard, additional reserve capacity has been made available at any one of several points along the New England coast; approximately twice as many hours of use of the investment can be secured in a term of years when compared with a stationary generating plant. As fixed charges are an important part of the cost of energy from a stand-by plant, this increase in the number of hours of operation should reduce the kilowatt-hour cost of the energy.

In a market widely scattered over a large area, the load center of the system may shift considerably more than in the case of compact metropolitan districts, and scattered

loads may make necessary the building of additional high tension line capacity for use with the steam auxiliaries for short periods, if the steam capacity is located at one point. A considerable investment in high tension lines is saved by being able to move the floating power station from one point to another along the coast.

Among the expensive features of the usual generating plant are the foundations and the provisions for condensing water into and out of the power house. In the case of a ship, the condensing water surrounds the plant, and it is necessary only to bring the water through the side of the hull and pass it out through the other side after it has gone through the condenser.

The *Jacona,* the ship on which the generating equipment is to be installed, was a cargo vessel of 7,000 tons, 380 feet in length, 50 feet beam, and 26 feet draft, and was purchased from the U. S. Shipping Board. It is being reconditioned by the Newport News Shipbuilding & Dry Dock Company, which is also installing the equipment.

The installed capacity of this floating power house will be 20,000 kw. and will consist of two General Electric turbine generators, each rated 10,000 kw. and operating at 3,600 r. p. m. These turbines are of the very latest design and are standard power house machines in every respect, and the only unusual feature involved is that they will be installed in a ship instead of in a central station. The turbines operate on steam at 400 lbs. pressure and 250 deg. superheat and exhaust into condensers at one-inch mercury back pressure. With these good steam conditions the steam consumption is between 9 and 10 pounds per kilowatt hour. The turbines will drive direct connected 10,000-kw., 0.8 P.F. generators which will produce 60-cycle power at 6,900 volts delta, or 11,930 volts Y. The generators will employ the closed system of ventilation, and the circulating air will be cooled by General Electric surface air coolers, through which sea water will be circulated.

The boiler equipment will be four Babcock & Wilcox marine-type boilers, capable of furnishing 240,000 lbs. of steam per hour at 425 lbs. and 250 deg. superheat. They will be oil fired, each furnace being equipped with eleven B. & W. burners of the Cuyama design. The furnace walls will consist of B. & W. No. 80 fire brick and special insulation. Each boiler will be equipped with air preheaters. The boiler plant is planned to develop 83 per cent efficiency. Two boilers are equipped with resuperheaters to provide steam for heating fuel oil and for miscellaneous purposes. All boilers, superheaters, and air heaters are equipped with Diamond soot blowers. Both forced- and induced-draft fans will be used, and two boilers will be connected to a short steel stack.

The center of the vessel is occupied by steel tanks. One will be used as a water tank, the other as a surge tank, holding a supply of hot water in emergency for boiler feed purposes. The make-up water will be supplied by a shore connection, and will be passed through evaporators for purification. All water for boiler feed goes through feed-water heaters for temperature control, and is deaërated.

The boiler plant will be forward and room will be left for possible future coal crushing equipment. The turbine equipment will be aft, and the switchboard equipment occupies the intermediate deck toward the stern. The crew's quarters, fore and aft of the cabins on the upper deck amidships, will not be disturbed.

One mast will be unshipped to provide room for the boiler stacks; and the other, which is equipped with boom and hoists, will be kept in place to assist in installing turbine and condenser equipment. Condensing water connections will be arranged on both sides of the hull.

The *Jacona* was an oil burner, equipped with a double bottom and space for both oil and water storage. These tanks will probably be used for water ballast to trim ship and give proper weight. In addition, the fore and after peak tanks will be used for ballast.

It is proposed to tow the vessel to its berth, and to make water, oil, and electric connections to existing facilities ashore.

AVIATION

Seventeen-Passenger British Seaplane

New York *Times,* May 25.—A twin-float, all-metal, passenger monoplane, which will weigh more than nine tons, is being built in England, according to advices to the Department of Commerce. Its span is 107

feet, with a distance of more than 20 feet between the floats.

The rather square box-type of fuselage gives a spacious cabin, where a tall man can stand upright; the flat sides allow large sliding windows, and the monocoque construction eliminates all inside struts or braces. The size of the fuselage enables a clear passageway into the tail and also provides a large space for baggage. The pilot's cabin is entirely enclosed; the roof is of safety glass, so that a clear view can be secured all around, and a panel can be slid back if necessary during mooring. Between the pilot's and passengers' cabins is the operator's and navigator's compartment, and a wide door, with a ladder up one strut, provides access to the passengers' quarters.

Three Bristol-Jupiter geared engines, giving a total of 1,575 horsepower, are fitted in cradles with anti-vibration rubber insulators. The central engine is set low in the nose, and the other two are slung under the wing with their oil tanks. The main spars of the wings are built up of duralumin sheet. The leading edge, back to the front spar, is duralumin sheet, and a metal walkway on top of the wings is provided, with other walkways back to the aileron hinges. Otherwise, fabric is used as the covering.

Gravity fuel feed is provided from tanks in the wings, where 350 gallons can be carried. This amount should carry the plane 500 miles. It is said that the airplane will be able to reach a speed of 136 miles per hour. The fully laden weight is 20,685 pounds, of which 7,984 pounds are available for load. There is space for seventeen passengers. The plane has a landing speed of 67 miles per hour on water.

Randolph Field Project

Baltimore *Sun*, June 1.—Randolph Field consists of 2,300 acres and will cost $20,000,000 with a possible final expenditure of $50,000,000. It will have a personnel of 5,000 persons, graduating 1,125 flyers from the primary stage of training annually. The annual cost of upkeep at the field will be over $11,000,000.

The design of this enormous field is unique in that the entire building area of 425 acres is situated in the exact center of the plot, leaving some 1,800 surrounding acres for flying.

The advantages of this arrangement are as follows: It is the only arrangement that will provide a flying line of sufficient length to accommodate the required number of airplanes; taxiing of airplanes is reduced to a minimum and maintenance, operation, and school activities are more concentrated, tending toward economy of effort and transportations.

The almost square building area will contain about 700 buildings when completed. All structures on the field will be of masonry and will be after the Spanish design of architecture. Three sides of the area will be lined with hangars, making a total of twenty-two hangars covering almost three miles. Some 400 planes will be housed in the twenty-two hangars.

The layout of the field resembles an enormous spider web. Behind the hangar lines there will be field accommodations such as the school for children, the hospital, the auditorium, the theater, the sports grounds, etc. The center of the area is laid out in a large circle with roads radiating from the officers' club in the center to the outer edge of the circle.

The eighteen miles of road in the area have been completed and stand today ready for the paved topping to be applied when all building on the reservation has been completed. Two warehouses, the air corps warehouse and the quartermaster's warehouse, will be completed and work on some 115 other buildings will be under way.

Four large contracts for building have been let and will be under way by June 20 and 21. The first, for $1,223,000, is for the construction of two warehouses and six barracks. Other contracts have been as follows: 10 field officers' quarters, $142,000; 42 sets of officers' quarters, and 130 sets of non-commissioned officers' quarters, $1,331,321, and guard house, $29,000. It will be one year before any of these contracts are finished.

The flying area has been well attended. After preliminary grubbing and surveying, the field was leveled and several hundred acres sodded with Bermuda grass. After the first 400 acres had produced seed the remaining portion of the 1,800 acres of flying area was sodded. The entire flying area will be covered with Bermuda grass.

Randolph Field is so called as a tribute to Captain William M. Randolph, who was killed on a cross-country flight near Gor-

man, Texas. Captain Randolph was a native of Texas, having been born in Austin, and was adjutant of Kelly Field at the time he met his death.

The field, which is the largest and only one of its kind in the world, will combine the primary training now given by the government at Brooks Field, San Antonio, and March Field, California.

Senate Report on U. S. Naval Air Forces

New York *Herald Tribune*, June 22. By Francis D. Walton.—The Senate Committee on Naval Affairs has found that the air force of the United States Navy is the peer of any in the world.

"We believe from the reports submitted," says the Navy report, "that in the number of planes, speed of planes, and general bombing and fighting equipment our Navy has pursuit and bombing planes of such number, type, and supremacy over any other nation in the world."

The Navy Committee findings might be regarded as a mere patriotic boast if the publication of the report did not coincide with a public statement by a leading authority on one of the nations which is committed to an inferior place by the Senate Committee's findings.

Lord Beatty said in a recent statement made in London and referring to the British Navy:

> The Navy today is the most up-to-date and efficient navy in the world, except in one respect, and that is its air equipment.
>
> The air wing of the United States Navy, owing to the single control exercised over the United States Navy, is far ahead of our fleet air arm. They carry out exercises on a scale quite impossible in our fleet.
>
> Coöperation between their ship-borne and shore-based aircraft has reached a high state of efficiency; with us it is non-existent. In common with Lord Trenchard, I view with dismay the grim prospect of "superimposing expenditure for the air service on the already heavy expenditure of the Navy and Army." We are the highest taxed country in the world, and yet we commit ourselves to the extravagance of having three fighting services. Reduce them to two, and we should save millions of public money with greater efficiency, as in the United States.

The admission by Lord Beatty regarding the air forces assigned to work with the British Navy, coming on top of the Senate Navy Committee's report, gives considerable weight to the latter's findings; but the concluding statement in Lord Beatty's remarks is also said to have special significance for America.

For years there has been under way in this country an effort to establish a separate air force, to have three fighting services—the Army, the Navy, and the Air. Proponents of this plan have argued that it would bring greater economies and that even a more intensely unified fighting power would result, as all three forces would be under one controlling power, which would be vested in a department of national defense.

It is interesting, both from the viewpoint of the proponents of the plan and those of its critics, that Great Britain, which has such a system, explains its inferiority to the United States by the very same arguments that have been urged by the advocates of a separate air force and a unified department of national defense in this country.

In one respect experts who have analyzed both the Senate Committee report and the full text of Lord Beatty's statement find that both are overgenerous. This feature is in regard to speed. American Navy planes may be, as Lord Beatty admits, in a "high state of efficiency . . . . and be capable of carrying out exercises on a scale quite impossible in our fleet," but in individual combat, where speed is of supreme importance, it is more than a shade doubtful, experts assert, that our own high-speed pursuit craft could keep up with that which could be put into the air by Great Britain.

Something of the Navy's lack in respect to air speed came to light on the occasion of the Senate Naval Committee's investigation into the case of Lieutenant Alford J. Williams, U. S. Navy (resigned).

It is also recalled that not so many months ago the Navy sent abroad and acquired a Bristol Bulldog fighter, the standard pursuit plane with the British naval forces. It was brought to this country for the express purpose, frankly stated, of discovering why the British naval air force was so much faster than our own. The first experiments with the Bristol plane ended disastrously and in the loss of the life of Lieutenant Cuddihy, one of the Navy's most brilliant flyers.

Although the report might give the impression that Navy authorities believe that they also have supremacy in speed, the need for the development of faster planes for

Navy flyers is quite frankly recognized in Washington and is accepted as a serious and important problem.

A substantial sum has been made available to the Bureau of Aëronautics for the express purpose of conducting experiments with fast planes. The results of these experiments, if justified, will be the basis upon which the Navy will ask for funds to provide new types of standardized fast fighting craft.

Tests of "XFJ-1"

Baltimore *Sun*, June 22.—The *XFJ-1*, fast fighting plane built for the United States Navy by the Berliner-Joyce Aircraft Corporation, of Baltimore, was put into a 12,000-foot vertical dive during its recent tests, it was revealed yesterday by Temple N. Joyce, one of the vice presidents of the company, who piloted the plane.

Mr. Joyce put the plane into every sort of a maneuver in the presence of navy officials at the Naval Air Station at Anacostia.

Beginning at about 16,300 feet, Mr. Joyce said, he dove the little plane straight earthward to an altitude of 4,600 feet. This is one of the tests required of all planes by naval regulations.

Even more remarkable from the standpoint of performance, it was asserted, was the ability of the plane to abruptly pull out of the long vertical dive. Mr. Joyce said he succeeded in leveling the ship off before reaching 3,500 feet.

Now that the plane has demonstrated its flyability, it will be tested for performance. These tests, which will be conducted this week, will determine the plane's top and landing speeds, its climbing ability and whether it measures up to contract requirements.

The plane then will be taken to Hampton Roads, where it will be given further tests by the Navy. These will include a test with the deck-arresting device used in halting planes quickly when they land on carriers.

Plans for Operations of World's Largest Plane

New York *Times*, June 22. By Kendall Foss.—Soon the twelve roaring motors of the Dornier *Do-X* will be heard again at Friedrichshafen as the flying ship which last summer, with less powerful motors than those now being installed, cruised for nearly an hour over the deep green waters of Lake Constance with a load of 169 persons on board, takes the air again. The 500-horsepower air-cooled motors are being replaced with water-cooled American engines developing 625 horsepower each—a total of 7,500 horsepower—which the engineers in charge are confident will enable the *Do-X* to outdo her performance of October last.

And when the trials have been completed, it is planned to fly the *Do-X* to America, there to demonstrate her suitability as a coastwise passenger carrier.

The all-metal flying boats are the creations of Dr. Claude Dornier, once an engineer in the Zeppelin works and now the genius behind the Dornier Wals (whales), Superwals, and the giant Dornier *Do-X*, largest flying boat in the world. The Dornier works are, like those of the Zeppelin company, only construction plants. The ships turned out at Manzell, about a mile along the lake front from Friedrichshafen, and at Altenrhein, across the water on the Swiss side, are mostly constructed on contract for commercial flying services, governments and private individuals who want air yachts capable of weathering almost any kind of a sea if forced to land unexpectedly.

Dr. Dornier's theory, ever since he started making flying boats just before the war at the request of Count Zeppelin, has been to strive after ever larger and larger ships. Asked whether the *Do-X* might be considered the last word, he replied: "By no means. I intend to construct a still larger flying ship in the near future." He smiled. "And then I shall probably get to work on one even larger than that," he added.

But for the present the reconstruction of the *Do-X* with a view to making a transatlantic flight, probably in August, is the absorbing topic in the Dornier plant. The ship stands now in the great forehall of the Altenrhein works without any motors and with her entire interior fittings removed to facilitate the work of installing the twelve new Curtiss Conqueror, 625-horsepower, 12-cylinder, water-cooled engines. These motors, as was the case with the air-cooled ones first used, are arranged in tandems. Six propellers (four bladed) face forward and six astern. The two revolve against each other. It has been found that mount-

ing one motor directly behind the next does not cut down the air pressure in which the rear propeller turns to any really appreciable extent. What loss there is, is further compensated for by having the rear motors revolve in an opposite direction.

These motors are mounted on the forward edge of the giant single wing, a wing having a spread of 144 feet and being thick enough at its leading edge to permit a man to crawl through it from the control room in the middle to the openings up into the enclosed space between the motor tandems. He remains protected from the wind the whole time and can adjust or repair a motor during flight with little difficulty. The ship is designed to fly effectively with only ten—any ten—motors in action and to remain in the air for a considerable period with only eight turning. This leeway, coupled with the accessibility from within, provides a safety factor of high value.

The 120-foot hull of the *Do-X* is arranged in two decks, the lower for passengers and the upper for the crew. In the hold below the lower deck there is ample space for gasoline tanks with a capacity of 3,521 gallons. The cabin itself extends from near the bow through to where the tail becomes too low and too narrow for comfort, and includes a cocktail bar, a smoking room, a lounge, and comfortable quarters for the passengers. Above are the control rooms, beginning with a pilot house, then a navigation room, then the engine-control room, and finally a little radio room. Behind this is a cuddy where an auxiliary motor provides air pressure for starting the engines and electricity for lighting and for operating the wireless.

The controls are arranged in duplicate, permitting change-over of pilots while in flight. The relief merely has to slip into the unoccupied pilot's seat, place his feet in the rests which control the vertical rudders, grasp the wheel which operates the horizontal rudders and get the feel of the ship before the other man beside him lets go. The arrangement looks much like one of those dual controlled automobiles sometimes used for teaching the art of driving.

The *Do-X* weighs just over thirty tons and can carry a useful load of twenty tons besides. Normal full load is fifty-two tons. This load must, of course, be distributed among passengers, freight, and gasoline in proportions depending on the distance to be flown. At the time of the record-breaking flight, there was only enough gasoline aboard to permit a short flight. The ship remained in the air just under an hour.

On the coming transatlantic flight it is planned to dispense with passengers entirely, taking only one or two newspaper correspondents and a few engineers aside from the crew of ten. There will be a small amount of mail and express freight, but the majority of the available weight allowance will be devoted to extra gasoline. There is, of course, a great temptation to take paying guests on the trip to cover the expenses, and Dr. Maurice Dornier, brother of Claude, laughingly declared recently that he had had three requests from America to be allowed to come on the trip. Two men offered to pay $10,000 apiece and a woman said she would pay whatever was asked if only she might be included. Dornier intends to turn all offers down.

Captain Christianson, who will command the ship, explained:

> She is not meant for a long distance record-breaker and the flight to America will not attempt any records. Her real usefulness is for commercial work over distances around a thousand miles. For such flights she can carry enough passengers and freight to pay her way. On longer hops—such as we shall have to make in bringing her to America—her ability to pay for herself is naturally eliminated.

Captain Christianson is an old sea captain with many years in the German merchant marine to his credit and with ten years' flying experience as navigator. He went on outlining the plans he and the Dorniers have in mind for the ship:

> As soon as the motors are installed—and they ought to be in before the first of July—we shall take her out and give her a thorough test on the Bodensee. Then, if all goes well, we shall start on a long European tour, touching at Amsterdam, Copenhagen, Stockholm, Oslo, Southampton, and finally Santander in Spain. By that time we shall know exactly what the ship can do. From there we hope to start for America, via the Azores and Bermuda, without returning to the Bodensee. As nearly as we can figure now, we ought to be in Santander around the first of August. But such things are impossible to fix definitely. It is even possible that our arrival in Santander may be too late in the summer for a start across the Atlantic to appear advisable. Who can say?

Dr. Maurice Dornier, who is in charge of the business end of the company, is very anxious to see the start for America take place this summer without fail. He said:

We hope to get her over there early enough in the year to permit a tour of the country before bad weather sets in. But more important, almost, is getting her out of the hall where she now stands.

To those who have met and talked with the men in the several works in and around Friedrichshafen, there is no doubt that still other world-startling achievements will come out of these shops in the not too distant future. What they will be, one cannot say, but it is certain that the *Do-X* and the *Graf Zeppelin* will not prove to have been the last triumphs of the Bodensee in the new field it has adopted, now that armies no longer tramp its shores.

New Aërial Photographic Record

U. S. Air Services, June.—Captain Albert W. Stevens, Air Corps photographic phenomenon, recently succeeded in taking a photograph covering a distance of 270 miles in one single exposure. This accomplishment adds almost 50 miles to the previous long-distance photographic record established by him last August, when his camera registered objects 227 miles distant.

The photograph taken by Captain Stevens during a flight 20,000 feet above Crater Lake, Oregon, gives a remarkably clear picture of the various mountain ranges stretching northward to the lofty peak of Mt. Rainier, 14,000 feet above sea level. Crescent Lake and Diamond Peak appear in the foreground, then follow the Three Sisters, 125 miles away; next Mount Jefferson, 175 miles off; Mount Hood, 200 miles away, and, finally, in lone majesty on the edge of the horizon, Mount Rainier.

Captain Stevens took the picture from an Air Corps photographic plane, piloted by Lieutenant John D. Corkille. Taking off from Mather Field, Sacramento, Calif., at 6:30 A.M., on the morning of the mission, the plane climbed steadily for almost a full hour as they flew northward. When the craft reached the upper air lanes over Crater Lake the altimeter on the plane registered 20,000 feet, while the thermometer stood at 20° below zero. Captain Stevens stated:

We didn't mind the low temperature as much as the lack of oxygen in the air. We got the oxygen we needed from a liquid oxygen supply, but finally had to come down after four hours, when our supply was exhausted.

Shooting at Mount Rainier from a distance greater than that between New York City and Washington is much like shooting at the moon with the difference that you can see the moon. The principle task is to aim the camera in the general direction you believe your objective to be, snap the trigger and hope for luck.

While I am very well satisfied with the results obtained on this particular mission, I am inclined to believe that it will only be a matter of time before we will develop a camera that will record even greater distances.

Tests of Steam-Powered Plane

Aviation, June 7.—Test flights of an airplane propelled by steam will be made at the Curtiss-Wright Airport, Alameda, Calif., in the near future, according to plans announced by William J. Besler, pilot-inventor. Experimental work on the engine, a 2-cylinder compound type, has been under way for more than a year under the direction of Besler and Warren Doble, automobile engine builder. The engine will have approximately 150 hp. and weighs about 300 lbs.

Besler, who has spent years studying engine development in Germany and other countries of Europe, is convinced of the practicability of steam power for airplanes and of the advantages of an external-combustion engine. The test flights are to be made in a Curtiss Robin, with the coöperation of the Curtiss-Wright flying service.

Navy Airship Base Hearings

Aviation, June 7. Washington, D.C.—Entering the third week of the hearings of the House Naval Affairs Committee on the selection of Sunnyvale or Camp Kearny, Calif., for the site of a lighter-than-air base, the possibility appears that neither site will be chosen. The General Board of the Navy, an advisory body to the Secretary of the Navy, has recommended the selection of Camp Kearny, near San Diego, while four members of the West Coast Board, a five-man board of naval aëronautical experts chosen to survey the Pacific Coast for sites, have recommended Sunnyvale.

In addition to this disagreement, three points have been brought out which make the location of the base on the southern or central California coast less of a certainty than appeared at first. According to the members of the General Board, the base should go to Camp Kearny because that site is 455 miles nearer the Panama Canal than is the Sunnyvale site. Admiral Moffett testified, however, that the first defense of the

canal by lighter-than-air craft would come from the ship stationed at Lakehurst, as that hangar is only 1,900 nautical miles from Panama, as compared with a distance of 2,891 miles from San Diego.

A second point which is assuming significance is the so-called "top-heaviness" of naval aërial activity in southern California, as contrasted with the paucity of such activity in the northwest.

The third point made by some members of the committee is that this station is not immediately needed. Repeated quotations have been made from former testimony to the effect that the first of the two dirigibles under contract could be housed with the *Los Angeles* in the present hangar at Lakehurst.

In reiterating the majority vote of the West Coast Board for the Sunnyvale site, Admiral Moffett further recommended the establishment of mooring masts at Nome, Alaska, Hawaii, Camp Kearny, and the Panama Canal. The transfer of naval heavier-than-air activities from leased fields in the vicinity of San Diego to Camp Kearny was also advocated by Admiral Moffett. He further stated that the first of the two new airships would operate on both coasts, if a hangar were provided on the West Coast, but its home base, he said, would be at Lakehurst.

Handley Page 40-Place Planes Near Completion

Aviation, June 7.—The first of eight 40-passenger Handley Page transports to be used by Imperial Airways on empire routes is about ready for flight testing. This machine, when put on active service, will be the largest in operation on any scheduled airline, and will represent the English company's attempt to bring closer to solution the problem of operating economy by increasing the number of passengers carried per plane.

These machines are of the usual Handley Page biplane construction. The top wing has a span of 135 ft., the fuselage is 89 ft. long, and the machine stands 25 ft. high. It is powered with four Rolls-Royce engines, producing a total of about 2,000 hp. The lower wing is slightly shorter than the upper wing and approaches a sesqui-plane in type.

Particular attention has been paid to the comfort of passengers. In order to eliminate noise, the cabin has been lined with balsa wood and the fuselage has been placed below the level of the engines in order to eliminate, as much as possible, the noise and vibration from that source. The cabin is divided into two compartments, each one accommodating twenty passengers. When used on some parts of the Indian route, it is planned to carry only twenty passengers and devote the balance of the weight to cargo. Hydraulic brakes have been installed and bracing wires between the inter-plane struts have been eliminated. Each plane, following the standard European practice, will be equipped with radio. All of these airliners have Handley Page slots. It is understood that the first machines completed will be placed in service on the London-Cairo route, to care for traffic expected on the proposed London-Cape Town line.

Lord Beatty's Reply to Lord Trenchard

London *Times*, May 1.—Sir,—Lord Trenchard's letter to *The Times* of April 25 is a continuation of, and supplementary to, his utterances in the House of Lords on April 9 last—a plea to justify a further extension of air control.

What does air control mean? The most advertised example of air control and the financial saving effected by its adoption was the operations in Iraq in September and October, 1924. What did the forces consist of? Twenty-four aëroplanes, twelve armored cars, eight guns, 3,630 men, cavalry, infantry, and artillery. This is not air control any more than armored car or artillery control. It was definitely military control, and the operations were military operations.

Fortunately the distinguished officers of the R.A.F. who were in command *were* soldiers. Whether the prospect, inevitable under the present régime, that in the future they will not have a soldier's training and experience can be contemplated with equanimity is another question.

Is it suggested that if these military operations had been carried out under a properly qualified military commander they would not have been as efficient and as economical?

Lord Trenchard makes vague statements, such as "Air is the greatest civilizing influence these countries have ever known," and "Air methods are the reverse of the old punitive column." When examined, it is found that all that these high-sounding phrases really mean is that a political officer can do his work much more thoroughly and

efficiently if he is provided with aëroplane transport than if he is without it. That is a truism, and nobody would contest it. Expedited transport of any kind assists control. Political officers were in existence before the advent of the air service, and our methods have always been "prevention, not only of punitive action."

Lord Trenchard admits that when it is found necessary to take extreme measures the only method is that of "bomb and run away"—which, as pointed out by Sir Frederick Maurice, can achieve nothing permanent. In fact, the arguments in Lord Trenchard's letter are found to lead nowhere. A military force equipped with air weapons, although commanded by an R.A.F. officer, exercises military control and not air control. Air forces are an indispensable part of, and an adjunct to, fighting forces, whether sea or land, as Lord Trenchard admits. But those air forces are necessarily under the command of the Army or Navy commander, who alone can coördinate their activities with those of the other units composing the whole force. The efforts to discover an independent rôle lead inevitably to the adoption, as a basic war aim, of attack on enemy non-combatants. Many students of war are firmly of the opinion that this aim is fallacious; that it cannot lead to victory; that it is inexpedient, particularly for this country; and that it is unacceptable to the great majority of Englishmen.

Lord Trenchard on April 9 in the House of Lords, in his endeavor to justify the existence of and expenditure on, a separate air service, proposed taking over the peace duties of the Navy and Army. He suggested substituting Air for Navy in the Red Sea and Persian Gulf. Apart from the fact that the work and conditions are such as to make it impracticable, no economies would arise. The strength of the Navy is based on war requirements and not on peace duties. If vessels were to be released in one sphere they would be utilized for services in other spheres where they are badly needed.

Sir, the Navy today is the most up-to-date and efficient navy in the world, except in one respect, and that is its air equipment. The air wing of the U. S. Navy, owing to the single control exercised over the U. S. Navy, is far ahead of our fleet air arm. They carry out exercises on a scale quite impossible in our fleet. Coöperation between their ship-borne and shore-based aircraft has reached a high state of efficiency; with us it is non-existent. In common with Lord Trenchard I view with dismay the grim prospect of "superimposing expenditure for the air service on the already heavy expenditure of the Navy and Army." We are the highest taxed country in the world, and yet we commit ourselves to the extravagance of having three fighting services. Reduce them to two and we should save millions of public money with greater efficiency as in the United States.

Lord Trenchard said in the House of Lords: "I shall not touch upon civil aviation at all." Surely it is a subject on which the public requires information and it is a branch of the air in sad need of support. The figures quoted in a letter to *The Times* of April 4 giving the number of miles of air routes developed by other countries and ourselves, and the number of commercial aircraft possessed by them and us, indicate that what is needed is a department which will not concern itself with Navy and Army work, but will devote itself to the development of commercial aviation, in which we are the most backward among the great nations.

MISCELLANEOUS

Morale and Leadership

Military Engineer, May-June.—Addressing the Army War College, General Charles P. Summerall, Chief of Staff of the Army, said:

> If we consider leadership in its strategic and tactical sense we see that the modern development of staff functions has changed a commander's relationship to many of the responsibilities and opportunities that formerly rested upon one man. This has indeed been a necessary corollary to the magnitude of armies and of operations with the vast possibilities of speed in movement and transportation. Thus, in speaking of the high command, one refers not only to the individual, but also to a group of individuals, supplementing him and aiding him. It is a composite unit of well balanced and highly trained men in each technical specialty and not one individual, who centralizes in himself the control and the execution of military operations. If we analyze the qualities of a leader as given by the great masters of war, it is seen that even should he possess them all, they must likewise be distributed among a staff that thinks, advises, and plans, protecting him from error and making his decisions effective.
>
> Thus the commander must know the art of staff support and each member of the staff must know the art of command. Yet no commander can be replaced by any staff, however able the latter

may be. In the last analysis, the responsibility for decision and initiative must rest upon him, and he must have the attributes, the character, and the knowledge to be worthy of the confidence and the service of his staff. It is this training of command and staff to supplement each other that gives to our Command and General Staff School and to the War College, their power to supply leaders and leadership in war for any unit, however large, that our country might put in the field. Of this technical leadership you have ample opportunity to learn in your studies and your reading of biographies and campaigns so abundantly published.

In a recent lecture on one of our military operations you were reminded of the difference between formulating the best of plans and having them executed by the troops. The latter requires a form of leadership no less important than that pertaining to the technical command. It is, therefore, my purpose to interpret as far as possible the fundamentals of this indispensable process that is associated with one's personality, and that can be developed and employed by every one in varying degrees. It is presented to officers who will bear especial responsibilities and is given as though they were destined to face situations where the ideas expressed may be useful.

Like most simple things, the subject appears trite even to those who realize its value. Many of the thoughts are those formulated by Marshal Petain when asked how he restored the morale and the fighting power of the French Army. At the time he declared his intention of placing his experiences in writing. Yet after several years he concluded that such a contribution was unnecessary, and stated that the book of Du Picq contained all there was to be said of leadership in better form than he could express it. The essentials are few, but they are indispensable. Illustrations are too numerous to include in the time available.

As a preliminary to the exercise of leadership, authority must be vested in the leader. No man is greatly influenced by men to whom he owes no obligation. This is especially true of the profession of arms. Unless there is definite subordination there will be not only a lack of response, but there will be antagonism and resentment towards anyone who invades another's sphere of responsibility. Jealousy of rank and command or of any independent status is inseparable from military men, and it is essential that no one should assume authority not vested in him. The ablest leader, therefore, can influence only those over whom he exercises unequivocal control. There can be no such thing as coöperation in the military hierarchy. There must be unquestioned command or nothing.

It is far more difficult to exercise influence over others in the normal conditions of peace than in the face of danger or of difficulties in war. Men have a tendency to surrender their initiative and to seek the direction of some one in whom they have confidence when life or the issues of campaign or battle are at stake. The psychology of peace and of war is, therefore, vastly different.

Military rank and command carry the presumption of leadership. There are certain qualities, however, that will determine the degree to which that leadership will be effective.

Knowledge of his profession is indispensable to a leader. Mastery of the art of war can be gained by study, reflection, experience, and practice. It cannot be learned like a lesson and forgotten, but must be absorbed as a part of an officer's life, and it must increase with his added responsibility. It cannot be gained suddenly when a crisis approaches. Rather one must be prepared by all that has gone before to avail himself of his opportunities. The reputation of ability is a priceless asset.

To knowledge must be added the virtues of unselfishness, justice, fair dealing, consideration, care for subordinates, thoughtfulness, and conscientiousness in the performance of all duty. The force of example in loyalty and in sharing hardships exercises the strongest influence upon others. Criticism and complaining beget like evils and react against the offender if he be in authority. The leader must be everything that he desires his subordinates to become. Thus a leader is reflected by his command. He imparts to it his spirit, his purposes, and his personality. It is for this reason that he is held responsible for its failures or given credit for its successes. He must possess the native qualities of resolution and courage, for without them he would lose the respect of others and would not gain the confidence of his subordinates.

Thus equipped for his task, the leader may expect reasonable results from following certain well-understood psychological laws.

All impulses must come from the top. They must be transmitted by each echelon with such increase of power that they will reach the point of application with irrestistible force. Thus the will of the leader becomes the unquestioned law of the command. The principle applies to every element regardless of its size. It was for this reason that Napoleon said: "Men are nothing. One man is everything." No subordinate can substitute his wishes for those of the commander and any failure in the chain of command in executing the commander's will, will defeat the whole purpose.

Men think as their leaders think, and men know unerringly how their leaders think. There is no greater responsibility than that of clear thinking, for one must reflect in his expressions and his actions his exact thoughts. Discouragement and indecision in a leader will spread in an incredibly short time to the most remote point. A man who is physically ailing or mentally tired soon communicates his deterioration by his words and acts. He may paralyze a command by spreading his own disabilities to those who are capable of successful efforts. Indeed, every one is capable of additional effort save where wounds or sickness destroy physical power. The leader can call forth this effort by his own example and resolution. For this reason, commanders and staffs must keep physically fit by proper rest and nourishment. A leader who destroys his physique, hazards his command.

Just as demoralization and failure generally result from a disturbed state of mind, so the will to win comes from a lofty spiritual status which we call morale. Both can be created or developed by the leader. It is well recognized that fear is a creature of the imagination. In the same way great masses of men have been threatened by failure from the fictions expressed by such terms as "held up by machine-gun fire," "shot to pieces," "tired,"

"want to be relieved," "neighbors are not up," etc. The leader must be able to dispel such illusions and replace them by confidence and certainty of success. Men do not suffer harship and face danger and death through fear of punishment. They are nerved for their attacks by pride in their commands, self-respect, loyalty to their commanders and confidence in their power to succeed. These are the elements of true discipline and must be attained by instilling the traditions of the command, rewarding, if in ever so slight a degree, meritorious conduct and regulating tasks to the capacity of the troops to attain them. Nothing discourages like unreasonable objectives, and nothing so heartens men as the successful attainment of their missions. Thus, the arrangement for an assault should insure fire and power to reach each step rather than rely on chance, to make an indefinite penetration. It is useless to order discouraged men to attack or to defend.

Soldiers demand success. They will face danger and death unhesitatingly if they believe that they will achieve victory. On the other hand, they soon lose confidence in a leader under whom they have failed. Thus both victory and defeat may result from a simple state of mind.

Men fight for their leaders. It is doubtful if soldiers are deeply concerned about the abstruse international questions that produce wars, or even if they feel the urge to die just for nationality. They are influenced above all by the men who lead them and whom they admire and trust. It follows, therefore, that a leader must be known to his men. He must see and be seen by them and talk to them of their missions and responsibilities. His personality, whatever it may be, is his greatest asset. He should appear among them at times and places of danger and should inspire them by his demeanor and courage. This is especially necessary with green or unseasoned troops. There were notably few casualties among the officers who exercised the higher commands in the A. E. F. A General who falls at the head of his troops or among them may exercise a greater influence in death than he ever did in life. As a matter of fact, letters were sent from the high command to general officers in the A. E. F. directing them to visit their commands in action. If the war had continued, the presence of leaders in the lines would have been a growing necessity and there would have resulted a very considerable number of casualties among them. If they did not realize the necessity of their presence with the troops, it was because of the habit that had been formed in trench warfare of keeping command posts far back of the lines. In all training and study the necessity should be emphasized of placing the leader near his troops and of personally keeping him in contact with them, especially at critical moments. There are times when he must be where he can influence the battle through his agencies, and times when he must intervene directly. No rule can be prescribed, but his judgment as to where he should be in any phase must be unerring.

Men respond to praise rather than to blame. One of the strongest instincts of human nature is self-respect. If the proper appeal is made, every man will try to merit and receive approval and commendation. When once this quality is aroused, men may be trusted to defend it. Equally strong in human nature is the instinct of self-preservation. This force is aroused by harshness, unnecessary suffering, humiliation, and a sense of injustice. It creates resentment and hate, and no man can have the fighting spirit when he feels aggrieved by neglect or bad treatment. The smallest action of a commander spreads with incredible rapidity, and one individual in whom a sense of pride has been aroused or who has been provoked to resentment through harsh treatment will spread a reaction corresponding to the impulse that has been started through him.

Military men have long recognized a department of punishment and discipline and accepted the rule to let no offense escape. They should be even more sensitive to the need for a department of award that would permit no meritorious act to fail in receiving proper recognition. This may be anything from a word of "well done" to a citation and a medal, but it should never be omitted. All Orders of honor or distinction are founded upon this basic element of human nature. This principle has been embodied in instructions to the Army.

It has been said "Fight for your command and they will fight for you." No greater error could be made in psychology. A leader who fights his superiors will find corresponding opposition to himself among his men. Rather should one say, "Fight with your men and they will fight for you."

In the lower echelons every man must be under the eye of a leader. The difficulties of terrain, casualties, and the frailties of human nature cause great wastage in the ranks unless a leader of some grade is constantly on the alert to maintain cohesion and discipline. A leader must assert his leadership. By his resolution and force of character he must dominate both his staff and his combat troops. This does not mean that he can ignore or displace them, but he must be their support and their source of effort. The best plan and the most perfect orders are useless unless they are executed by the troops. It is the part of the leader to have his command understand his purpose and their responsibility, and to impart to them his own confidence and his plan and his certainty of success. The more they understand their mission and the measures and results to be accomplished, the more they will make it their own and consecrate themselves to it.

From the manifest value of proper leadership, the selection of leaders, especially for the higher echelons, becomes a grave responsibility. It is the purpose of our service schools and especially of the War College to develop capable leaders for all elements of an army. There can be no doubt that many officers have failed and have lost their commands not so much because they did not possess the innate ability, as because they had not learned the methods that should be pursued for successful execution. Our military training and our methods of selection have largely been responsible for misfortunes that could have been avoided. No war plan is complete without a blotter showing the selections for staffs and commands. With the present requirements, efficiency reports should show every officer regardless of his rank who by experience, character and attainments is qualified for such a selection.

NOTES ON INTERNATIONAL AFFAIRS

From June 3 to July 3

Prepared by Professor Allan Westcott, U. S. Naval Academy

RATIFICATION OF NAVAL TREATY

State Department Refuses Documents.—By direction of President Hoover, Secretary of State Stimson on June 6 declined to turn over to the Senate Foreign Affairs Committee the confidential correspondence of the Government with foreign powers preceding the London Naval Treaty, on the ground that the revelation of these documents would be a violation of international practice and of the confidence of the other nations involved. The Senate committee subsequently passed by a vote of ten to four a resolution declaring the right of the committee as the agent of the Senate to "all the letters, minutes, memoranda, instructions, and dispatches," but no further documents were surrendered, and President Hoover reiterated that there was "not one scintilla of agreement or obligation of any character outside of the treaty itself." On June 23 the Foreign Affairs Committee reported the treaty favorably to the Senate by a vote of sixteen to four. A minority report by Senators Johnson, Moses, and Robinson gave eleven arguments against the treaty.

Special Session for Treaty.—A special session of the Senate for ratification of the Naval Treaty was called by President Hoover to convene on July 7, and a vote was expected within two weeks' time, with over three-fourths of the Senate favorable to ratification. Voicing the opposition to the treaty, Senator Hiram Johnson of California in a radio speech on June 17 made seven specific points against it: (1) that the treaty does not make for economy; (2) that it calls for competitive construction on a large scale; (3) that it does not secure real parity with the British fleet; (4) that the ratio of 5-3 is violated in favor of Japan; (5) that our allottment of cruiser tonnage is not adequate or suited to our needs; (6) that the treaty abandons our traditional policy of a navy for protection of commerce in favor of a fleet designed for combat strength alone; (7) that our new cruisers must be built not to suit our real needs but to conform to British specifications.

Studies of the Treaty.—Among the articles of chief interest in the July number of the quarterly *Foreign Affairs* are two studies of the London Naval Conference, one from the American point of view by Walter Lippmann, editor of the New York *World*, and the other from the French standpoint by "Pertinax," the well-known political writer for the *Echo de Paris*. Mr. Lippmann presents a careful analysis of the problems of the conference, finding his chief argument for the treaty, from the American point of view, in the fact that nearly all the important naval powers have made immense progress since the Washington conference in construction of all types of auxiliary vessels, as compared with the United States, and the London treaty in some measure enables us to catch up. He figures that if there were a complete holiday in new construction from 1930 to 1936 the United States would be far below her ratio strength in large and small cruisers, destroyers, and submarines. Having effected an enormous expansion, Japan in particular, he states, consents to what amounts to a naval holiday for the next five years. "Pertinax" has

much interesting inside information about the working of the conference, and declares that it failed "exclusively on the Italian claim for parity with France." Against this claim he has much to say, blaming it largely on the English and American diplomats of the Washington conference who gave Italy an equal ratio with France when her own demands were for only two-thirds. Today Mussolini can hardly be prevailed upon to accept less than his "contemptible predecessors" got ten years ago. France, according to "Pertinax," should be granted her demand for "the strength of the Italian fleet plus 240,000 tons, that is, 140,000 tons as the equivalent of the German fleet, and 100,000 tons for service in colonial waters.

Among other articles in the July number of this quarterly there is a study of conditions in Haiti by former Ambassador Fletcher; of *American Difficulties in Porto Rico*, by Thomas E. Benner, ex-Chancellor of the University of Porto Rico; *Soviet Transport Plans*, by Bruce E. Hopper; and an account of the problems of the proposed tunnel across the English Channel.

UNITED STATES AND LATIN AMERICA

Foreign Protests Against U. S. Tariff.—The new tariff act passed by the Senate, forty-four to forty-two, on June 13 and approved by President Hoover on June 17, aroused not only some misgivings at home as to its effect upon our foreign trade, but official protests from many foreign nations and threats of trade combinations in retaliation. According to reports from the State Department, negotiations for new commercial treaties with more than twenty other countries, including France, Canada, Australia, Sweden, Poland, Brazil, and Czechoslovakia, have been held up during the past fifteen months of tariff discussion. There will now be further negotiations for special concessions under the flexible clause of the new act which gives the President power to raise or lower tariff rates. France in particular still hopes by "courteous intervention" to secure modifications favorable to French trade, especially in view of the fact that American exports to France in the first three months of this year have declined $390,000,000. Failing such concessions the customs committee of the French Chamber declared in a statement on June 17 that it would insist on suppression of the most favored nation clause in any future agreement with this country.

Naval Officer to Supervise Nicaragua Elections.—Captain Alfred Johnson, U. S. Navy, named by the Supreme Court of Nicaragua on President Hoover's nomination to supervise the Nicaraguan congressional elections of next autumn, sailed from New York on June 20 to take up his new duties, accompanied by a staff of officers of the Navy and Marine Corps. The enlisted personnel to take part in the supervision will consist of 310 enlisted men of the Navy from the submarine base at Coco Solo, Canal Zone, to arrive at Managua on July 10, and 54 marines who will be sent to Bluefields on the east coast at the same date.

During June there were reports of the return of the rebel Sandino to northern Nicaragua, and of encounters between outlaw bands and detachments of the Nicaragua National Guard. On May 8 a patrol of the National Guard headed by marine officers was ambushed by a bandit force of about 100, but dislodged the enemy after suffering a loss of four killed and two wounded.

Visit of President-elect of Brazil.—Returning President Hoover's visit of last year, President-elect Julio Prestes of Brazil arrived in New York on June 11 for a brief visit to the United States. The Brazilian Lloyd liner on which he made his voyage was accompanied by two Brazilian cruisers, the *Bahia* and *Rio Grande do Sul*, and was met off New York by the *Trenton* and *Marblehead*. Following his reception in New York Dr. Prestes went directly to Washington, where after exchange of formal calls he was entertained at dinner by President Hoover and welcomed on the day following by Secretary of State Stimson at the Pan-American Building. Upon his return to New York he was given a large dinner by the Pan-American Association, the American-Brazilian Association, and the Merchants Association on June 17, after which he sailed for an extensive European tour prior to his accession to office in November.

Revolution in Bolivia.—Reports from Bolivia at the close of June indicated that the revolutionary movement started there during the month was completely successful, only two regiments of troops having remained loyal to the Siles government. The capital La Paz capitulated to the insurgent forces on June 27. For the past two years President Siles had assumed dictatorial powers in Bolivia, ruling without a congress after deporting most of his political enemies. He resigned on May 28, but left his cabinet to carry on the government, and planned a convention to amend the constitution in order to permit his reëlection at the close of his regular term on August 6. There was considerable sentiment against Siles among army officers, and particularly against General Kundt, the German officer whom Siles made commander-in-chief of the Bolivian army. Siles was accused of trying to bring on war with Paraguay in order to maintain his control of domestic affairs.

Revolutionary disturbances began with the seizure of the frontier station of Villazon on June 17 by a small band of Bolivian exiles from Argentina. Ten days later the important commercial city of Arura was taken over by mutinous troops, and the fall of the capital followed quickly. A council of six army officers took control of the government and issued a decree declaring the fundamental aim of the revolution was to insure the constitutional order of succession to the presidency.

EUROPEAN NATIONS

Little Entente Conference.—A conference of foreign ministers of the Little Entente powers was held at Lake Csorba in Czechoslovakia, opening June 25, One of the chief topics of discussion at the conference was the possibility of an attempt at restoration of Hapsburg rule in Hungary, rendered more likely by the visit in May of Archduke Albrecht to the young Archduke Otto, son of former King Karl, in Belgium, at which Albrecht surrendered his claims in Otto's favor. The decision of the conference was to take all steps possible to prevent such a contingency, short of an open affront to the present Hungarian government.

Other matters discussed were the possibilities of Franco-Italian hostility in its bearing on middle Europe, and Premier Briand's Pan-Europa plan.

Success of First Young Plan Loan.—The first $300,000,000 reparations loan at 5½ per cent under the Young Plan was launched on June 12-13 and almost at once oversold in the nine countries which took part in the issue. The actual value of the allottment to the United States was $98,250,000. Of the proceeds of the loan France will receive $132,215,000; Germany, $100,000,000; Great Britain, $50,000,000; Italy, $13,105,000; Japan, $2,060,000; Jugoslavia $1,872,000; and Portugal, $748,000.

The successful flotation of the loan was regarded as marking the end of the reparations problem as a disturbing factor in international politics. Henceforth, if the plan works, reparation payments will be handled without friction by bonds issued through the Bank of International Settlement, the interest on which will be paid by Germany. Whether or not the burden will be beyond German capacity is another question, and in Germany the reparations problem is regarded as not yet settled (see "Germany and the Young Plan" by Carl Bergmann, in July *Foreign Affairs*). Incidentally, it may be recalled that, according to a "concurrent agreement" between Germany and her creditors signed after the Hague Conference, any reduction of the American claims against the Allies during the next thirty-seven years will be passed on to Germany.

In accordance with pledges made at the adoption of the Young Plan, the last French troops left the Rhineland on June 30.

Carol King of Rumania.—On June 6 Prince Carol of Rumania made a spectacular return to Bucharest by airplane after five years in exile following his forced renunciation of the Rumanian throne in 1926. His return was expected and favored by the Maniu Ministry, and in fact for some time it had been evident that the only real opposition to his return was from the Liberal party led by the powerful Bratianu family, and perhaps also from his mother, the Dowager Queen Marie. Three days previously it had been announced in Paris that he had definitely severed his relations with Mme. Magda Lupescu, which caused his banishment.

Two days after his arrival at Bucharest the Rumanian Parliament by a brief act annulled Carol's renunciation of the throne and declared that he had actually been *de jure*

ruler as Carol II since the death of his father three years ago. Coronation ceremonies were set for next October. The cabinet headed by Dr. Julius Maniu resigned for a few days but was soon reorganized with practically no change. The Liberal party maintained its position in opposition to Carol's restoration, though his return was made possible largely by the support of George Bratianu, a younger leader of that party. In the European press there was much skepticism as to Carol's possibilities as a ruler or as a stabilizing factor in Rumanian politics.

COMMUNIST PARTY CONGRESS.—The supremacy of Joseph Stalin in the Soviet government and in the councils of the Communist party was again demonstrated at the sixteenth biennial conference of the party which opened at Moscow on June 26. Speaking for seven hours to the 2,000 delegates, Stalin reported the doubling of state industry in the last three years and marked progress in other fields, and was greeted at the end with a tremendous ovation. In a preliminary conference at Moscow he had secured unanimous support for a resolution approving the government's policies in all particulars and condemning opposition from both Right and Left in the Central Committee. It was expected that at the party congress new men of Stalin's choice would be elected to take the places of the discredited Right leaders Bukarin and Tomsky.

In a recent German work on Bolshevism by Arthur Feiler, an editor of the *Frankfürter Zeitung*, the present Soviet government is again characterized as neither a Socialism nor a Communism of the Marxian pattern, but a type of state capitalism, with exclusion of private capitalists, in the interests of a small body of industrial workers and revolutionary intellectuals who constitute neither a class nor a party—a government which could not work for a week without the protection of army and police.

BRITISH EMPIRE

INDEPENDENCE MOVEMENT IN EGYPT.—The anti-British agitation in Egypt carried on by the Wafd or Nationalist party increased in intensity upon the refusal of King Fuad to approve the recent bill passed by the Egyptian parliament for safeguarding the constitution and inflicting severe penalties on ministers who suspend constitutional liberties. The cabinet headed by Nahes Pasha resigned on June 17, following the King's action, and after the organization of a new cabinet under Ismael Sidky Pasha parliament was adjourned for a month by royal decree. Despite its dismissal, the parliament attempted a session and broke through the police cordon surrounding the parliament house.

JEWISH PROBLEM IN PALESTINE.—During June the problems raised by the conflicts between Jews and Arabs in the British mandate of Palestine were under discussion both at the inquiry into the 1929 disturbances carried on by the League Mandates Commission at Geneva and at the investigation of the Wailing Wall controversy in Jerusalem by a special league commission. To the latter, a 100-page memorandum stating the Jewish side of the case was presented on June 25 by Dr. Cyrus Adler, President of the Jewish Theological Seminary of America.

SIMON REPORT ON INDIA.—The long-awaited report of the Simon Commission on India was a voluminous document published in two parts; the first on June 9 presenting a general survey of the problems of race, religion, caste, language, education, and economic conditions which complicate the governmental question; and the second on June 24 offering specific recommendations. In general terms the report proposed the separation of the great province of Burma on the east from the rest of India, and the development of self-governing institutions in the other eight provinces, which would still be under British governors with sweeping powers. A federal assembly was proposed to which delegates would be sent from the provinces as well as from the states under the rule of native princes. These latter have a population of 72,000,000 out of India's total of 319,000,000.

The report was very generally condemned in the Indian press as far too conservative and wholly failing to meet the present situation. The nationalist movement planned to disregard it completely, and in view of the general hostility it appeared doubtful whether Indian political leaders would dare

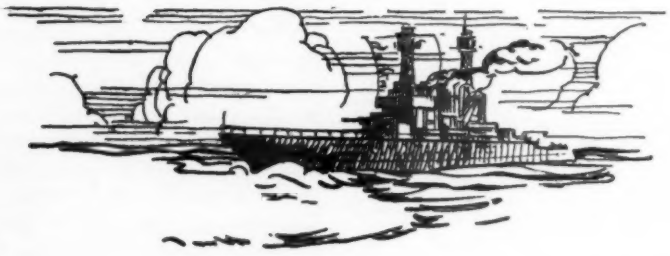
attend the round table conference in London set by the government for October 20.

The Civil Disobedience Movement.—Through June the anti-government agitation in India under the direction of the Nationalist Congress continued with possibly diminished violence, owing partly to the approach of the rainy season. Troops reënforced the police in suppressing disorders in Bombay, and the government anti-assembly, anti-picketing, and anti-sedition ordinances were used with increasing rigor. In a statement on June 17 the viceroy declared the situation somewhat quieter, with more open manifestations on the part of elements opposed to the Gandhi campaign. Boycott week against all foreign goods began on June 30.

CHINA

Continuance of Civil War.—During the middle of June there was a lull in the conflict between the Nanking and Northern armies in northern Shantung and along the Lunghai railway, but on June 25 the northern forces occupied Tsinan-fu, capital of Shantung. Taking advantage of the temporary quiet in the north, President Chiang Kai-shek, who despite rumors of his being wounded was reported still in active command, effected a concentration against the rebel and bandit forces advancing from the southward against Hankow and operated against them with some success. Changsha, capital of Hunan province, was recaptured from the Kwangsi rebels on June 18. At the close of the month northern and southern forces, totaling according to some accounts 300,000, were locked in a battle in northern Honan the outcome of which might prove decisive in the campaign.

Seizure of Tientsin Customs.—On June 6 Governor Feng Yu-hsiang put into effect his seizure of the Tientsin customs revenue by appointing B. Lennox Simpson (the English writer under the pen-name Putnam Weale) as commissioner in charge of customs at that port. Mr. Simpson formed a staff and began operations without protest from foreign consuls. Meantime the Nanking government declared the port of Tientsin closed, and made representations to foreign powers against the seizure. Collections at Tientsin last year exceeded $8,000,000.



Courtesy G. P. Putnam's Sons, New York

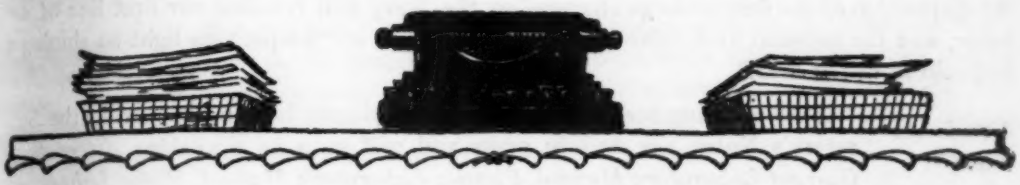
THE OLD ADMINISTRATION BUILDING, COASTER'S HARBOR ISLAND, NARRAGANSETT BAY, R.I.

This building, a two-story structure of stone, was turned over for use as the War College. Formerly an asylum for the poor of Newport, it had been converted into offices for the commandant of the training station. Rear Admiral Luce had fought for years for the establishment of a War College, and, when his efforts were successful, he was made its first president.

From an oil painting in the possession of his family.

REAR ADMIRAL STEPHEN B. LUCE, U. S. NAVY
The ninth president of the U. S. Naval Institute, 1887-98.

SECRETARY'S NOTES



Aviation progresses

Something more than a year ago the Secretary made a brief résumé of aviation progress, and took occasion then to predict some of the changes in the world's political alignments that might result from these developments. The past year has shown no slowing up of the accomplishments of those who build and fly seaplanes, landplanes, and dirigibles.

Traveling by train and plane the rail and air-passenger service keeps regular schedules for a two-day trip across the continent. The record of more than eleven days of continuous flight mentioned last year has been almost forgotten since the Hunter Brothers flew the *City of Chicago* for 544 hours.

Our air-mail service is continually expanding not only within the United States but also to the other countries on this continent and to South America as well. The traveler by automobile and train is impressed with the beacons, emergency landing fields, weather and radio stations, for serving the fliers, that he finds not only in populous districts but also on mountain tops and in desert areas.

Captain Hawks flew across the country in a glider towed by a power plane. At stop stations he unhooked his glider from the towing plane and glided to earth. One wonders what trains of the future this forecasts.

Colonel and Mrs. Lindbergh have shown what few stops are even now necessary in crossing from one of our coasts to the other; and the *Spokane Sun God* flew from Spokane to New York and returned in less than 116 hours without landing although it was refueled eleven times en route.

The *Graf Zeppelin's* numerous transoceanic flights, including one around the world, show full well that projected uses for lighter-than-air craft are far from visionary.

The Diesel-propelled plane has already been successfully flown. Who can tell the ultimate speed or ceiling? At the moment Squadron Leader Orlebar's speed of 357.7 miles per hour, and Lieutenant Soucek's altitude of 43,166 feet are the records.

Not only are spectacular things being accomplished, and new records being made, but the safety of flying is constantly improving. Lieutenant Doolittle, U. S. Army, has already demonstrated that "blind" flying is not an impossibility. The Curtiss *Tanger*, winner of the competition for safe aircraft, embodied principles and performances remarkable in promoting safety of aircraft operation.

In all these developments our Navy is well to the fore. It is not only in such things as the aerial survey of 13,000 square miles in Alaska, in Soucek's climb eight miles above sea level, or in Byrd's soul-stirring expedition to the South Pole, that the Navy has participated; but also in all the work, and trials, and tribulations, that make possible the steady progress in performance and safety.

What officer on rejoining the fleet after a long absence is not thrilled at the performances of our mobile aircraft in war games played far from any but a floating landing field?

The sea battle of the future will differ in many ways from those of the past, but the guiding principles which have brought success before remain unchanged. The composition and the disposition of the fleet undergo changes but the Navy still remains our first line of defense, and the aviation arm follows the Navy tradition of "keeping its light so shining a little ahead of the next."

New books in press The following books, that have not previously been mentioned in the Secretary's Notes, are now in press and will soon be available: *Alternating-Current Laboratory Manual, Physics Laboratory Manual, Radio Laboratory Manual, The First Twenty-five Years* (Class History Naval Academy Class of 1905).

Rear Admiral Stephen B. Luce The frontispiece for these notes is a picture of the ninth president of the Naval Institute. The following sketch is taken from notes furnished by Professor Herman F. Krafft, Curator of the Naval Academy Museum. Stephen Bleecker Luce, born in 1827, was destined, before his death at the age of ninety, to live through four wars. He was a midshipman on the *Columbus* under Biddle in Japan, the trail-blazer for Perry. Luce served with distinction through the Mexican and Civil Wars. During tours of duty in the Department of Seamanship and as Commandant at the Naval Academy, he left an indelible impression on the officer-training phase of the Navy. He founded the Naval War College. In this connection he discovered Mahan, and pointed him fair on his great *Sea Power* series. He was president of the Naval Institute for eleven years and contributed to its PROCEEDINGS many important articles. The mere titles of some of these reveal him as a thinker and the teacher of the Navy, e.g., "The Navy Department," "Naval Administration," "Naval Strategy," "Naval Training," "A Powerful Navy not Dangerous to Civil Liberty," and "The True Relation between the Navy Department and the War College." His *Seamanship* was for years the classic textbook in this subject at the Naval Academy, a subject now taught in the hall named in his honor.

But far greater than all this, "Luce taught the Navy to think." In an article in the Naval Institute PROCEEDINGS shortly after Admiral Luce's death in 1917, Admiral Fiske wrote: "The statement cannot reasonably be questioned that the U. S. Navy owes more to him than to any other man who was ever connected with it, directly or indirectly." A thousand men, untrained and unled, is a mob. With proper equipment and coördination in movements the thousand become a fighting unit. But such a unit may form a crack regiment, a crack ship, and yet not be able to accomplish its maximum in the battle line. Luce taught the Navy to think in terms of fleets as well as ships, in terms of grand tactics, strategy, naval bases, logistics, campaigns, wars. Luce, like Farragut before the battle of New Orleans, studied and explained battles and campaigns by moving miniature ships over great maps. For all this, many so-called "practical" officers of his day—those who prided themselves on being able personally to furl a sail, splice a rope, or do a trick at the wheel—some of these "practical" men considered Luce a theorist and a dreamer. But criticism could not embitter the genial and good-natured Luce. He and Mahan kept on preaching their doctrines, in and out of the War College, until gradually even those who came to scoff remained to pray.

At sixty Luce in full dress used to "skin the cat" from two hammock hooks in his cabin. Such gymnastic feats were probably as much a matter of exuberance of good spirits as a

conscious quest for physical fitness. To those who had the privilege of meeting him under his hospitable roof in Newport, he seemed, even in his eighties, wonderfully keen and alert, witty and quick in repartee, the quizzical look in his keen grey eyes full of good humor and humanity, every inch the officer and the gentleman.

Changes in editorial staff The Board of Control has accepted the resignation of Lieutenant Commander A. H. Rooks, U. S. Navy, as assistant editor, due to his assignment to sea duty. The Board elected Lieutenant Commander C. H. McMorris, U. S. Navy, who served on the Institute staff, 1926-27, to fill the vacancy created by Lieutenant Commander Rooks' resignation.

Naval Academy Graduates Association The following notice is published at the request of the President of the Naval Academy Graduates Association:

The annual business meeting of the Naval Academy Graduates Association was held at the Academy, May 31, 1930. At the annual dinner, Stayton, of the Class of '81, made the following report for the Council:

A year ago our Association had neither a definite program of activities nor a financial balance. Our work had been confined to issuing—periodically—a roster, and to arranging for "June Week" dinners. We had not then enough money to pay our debts, and were without a regular source of income. Our members are, generally speaking, life members, with dues paid up in advance, and exempt from assessments. The practice of taking fees and dues from midshipmen on their graduation day seemed objectionable and had been discontinued.

The Council's first effort was to plan for some worth while service work. The Secretary of the Navy, and the officers of the Navy Department and of the Academy were sympathetic and helpful and have enabled us to coöperate, in what we believe will be a valuable fashion—with the Bureau of Navigation.

The department has given us its recognition, and assigned us office space in the Navy Building.

The Council decided that there was needed an Emergency Fund of $10,000 to be immediately available for paying a secretary and for meeting other current expenses for a period of two years, during which time it is hoped to arrange for a regular income from voluntary dues.

The Council wrote to about fifty graduates and obtained from them an underwriting guaranteeing $5,000 per year for the next two years. The emergency fund of $10,000 is, therefore, available and on the first of July the Council, with a proper office force, will start on its two-year program. This program will involve the following activities:

(1) The Association will, on account of legal considerations, be incorporated under the federal laws of the District of Columbia.

(2) There will be a campaign to induce all graduates to join as regular members, and any former non-graduate students to join as associate members.

(3) All academy classes will be encouraged to organize, and every class will have a liaison officer tying up with the parent body.

(4) Members will be asked to consent to pay—for current association income—about $5.00 in every five-year period. Membership will, of course, continue whether or not such contribution be made.

(5) The work of increasing the permanent Endowment Fund—which now amounts to about $4,000—will be pushed forward, and the income be applied to current expenses.

(6) A new roster will be issued. The last volume was printed under pressure and in the face of great difficulties. It is unsatisfactory in form and substance, and unhappily contains many errors. Graduates are earnestly requested to suggest alterations and improvements for the new volume, and to send their suggestions to the Secretary, Lieutenant Commander R. S. Robertson, Jr., U. S. Navy, care Navy Department, Washington, D.C.

(7) The organizing of branches in the principal cities will be systematically carried on.

If these plans meet the approval and receive the support of the graduates, this Association will take a place worthy of the Academy and of the service.

Membership The membership of the Naval Institute continues to increase slowly but steadily.

Since the last membership statement was published in the PROCEEDINGS, the Institute's membership has increased by 26 members. During this same time there has been a total of 5 deaths and 12 resignations. The total membership of the Institute is 6,570.

This membership is comprised of:

2,347 officers on the active list,
288 officers on the retired list,
151 officers of the U. S. Coast Guard, and
3,784 associate members.

In addition to the membership the Institute has 875 subscribers and sends out in exchange with other publications, to advertisers, etc., 372 copies. The total circulation is therefore 7,817 copies.